WALK-IN VAN CHASSIS

Maintenance Manual

STI-471-6
A24-01451-000

WALK-IN VAN CHASSIS MAINTENANCE MANUAL

Models: MT45
MT45 G
MT45 HEV
MT55
MT55 G
MT55 HEV
MT55 HHV

STI-471-6 (11/15)

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Foreword

Scheduled maintenance provides a key element for safe operation of your vehicle. A proper maintenance program also helps to minimize downtime and to safeguard warranties. This maintenance manual provides information necessary for years of safe, reliable, and cost-efficient vehicle operation.

IMPORTANT: The maintenance operations in this manual are **not all-inclusive**. Also refer to other component and body manufacturers' instructions for specific inspection and maintenance instructions.

Perform daily pretrip inspection and maintenance as outlined in the vehicle operator's manual. Perform the operations in this maintenance manual at scheduled intervals based upon distance traveled or months of operation. Your authorized servicing dealer has the qualified technicians and equipment to perform this maintenance for you. Your dealership can also set up a scheduled maintenance program tailored specifically to your needs. Optionally, your dealership can assist you in learning how to perform the maintenance procedures in this manual.

IMPORTANT: Descriptions and specifications in this manual were in effect at the time of printing. Freightliner Custom Chassis Corporation (FCCC) reserves the right to discontinue models and to change specifications or design at any time without notice and without incurring obligation. Descriptions and specifications contained in this publication provide no warranty, expressed or implied, and are subject to revision and editions without notice.

Refer to **www.Daimler-TrucksNorthAmerica.com** and **www.FreightlinerChassis.com** for more information, or contact Daimler Trucks North America LLC at the address below.

Environmental Concerns and Recommendations

Whenever you see instructions in this manual to discard materials, you should attempt to reclaim and recycle them. To preserve our environment, follow appropriate environmental rules and regulations when disposing of materials.

NOTICE: Parts Replacement Considerations

Do not replace suspension, axle, or steering parts (such as springs, wheels, hubs, and steering gears) with used parts. Used parts may have been subjected to collisions or improper use and have undetected structural damage.

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Descriptions of Service Publications

Daimler Trucks North America LLC distributes the following major service publications in paper and electronic (via ServicePro®) formats.

Workshop/Service Manual

Workshop/service manuals contain service and repair information for all vehicle systems and components, except for major components such as engines, transmissions, and rear axles. Each workshop/service manual section is divided into subjects that can include general information, principles of operation, removal, disassembly, assembly, installation, and specifications.

Maintenance Manual

Maintenance manuals contain routine maintenance procedures and intervals for vehicle components and systems. They have information such as lubrication procedures and tables, fluid replacement procedures, fluid capacities, specifications, and procedures for adjustments and for checking the tightness of fasteners. Maintenance manuals do not contain detailed repair or service information.

Driver's/Operator's Manual

Driver's/operator's manuals contain information needed to enhance the driver's understanding of how to operate and care for the vehicle and its components. Each manual contains a chapter that covers pre-trip and post-trip inspections, and daily, weekly, and monthly maintenance of vehicle components. Driver's/operator's manuals do not contain detailed repair or service information.

Service Bulletins

Service bulletins provide the latest service tips, field repairs, product improvements, and related information. Some service bulletins are updates to information in the workshop/service manual. These bulletins take precedence over workshop/service manual information, until the latter is updated; at that time, the bulletin is usually canceled. The service bulletins manual is available only to dealers. When doing service work on a vehicle system or part, check for a valid service bulletin for the latest information on the subject.

IMPORTANT: Before using a particular service bulletin, check the current service bulletin validity list to be sure the bulletin is valid.

Parts Technical Bulletins

Parts technical bulletins provide information on parts. These bulletins contain lists of parts and BOMs needed to do replacement and upgrade procedures.

Web-based repair, service, and parts documentation can be accessed using the following applications on the AccessFreightliner.com website.

ServicePro

ServicePro® provides Web-based access to the most up-to-date versions of the publications listed above. In addition, the Service Solutions feature provides diagnostic assistance with Symptoms Search, by connecting to a large knowledge base gathered from technicians and service personnel. Search results for both documents and service solutions can be narrowed by initially entering vehicle identification data.

PartsPro

PartsPro® is an electronic parts catalog system, showing the specified vehicle's build record.

EZWiring

EZWiring™ makes Freightliner Custom Chassis Corporation, Freightliner, Sterling, Western Star, and Thomas Built Buses products' wiring drawings and floating pin lists available online for viewing and printing. EZWiring can also be accessed from within PartsPro.

Descriptions of Service Publications

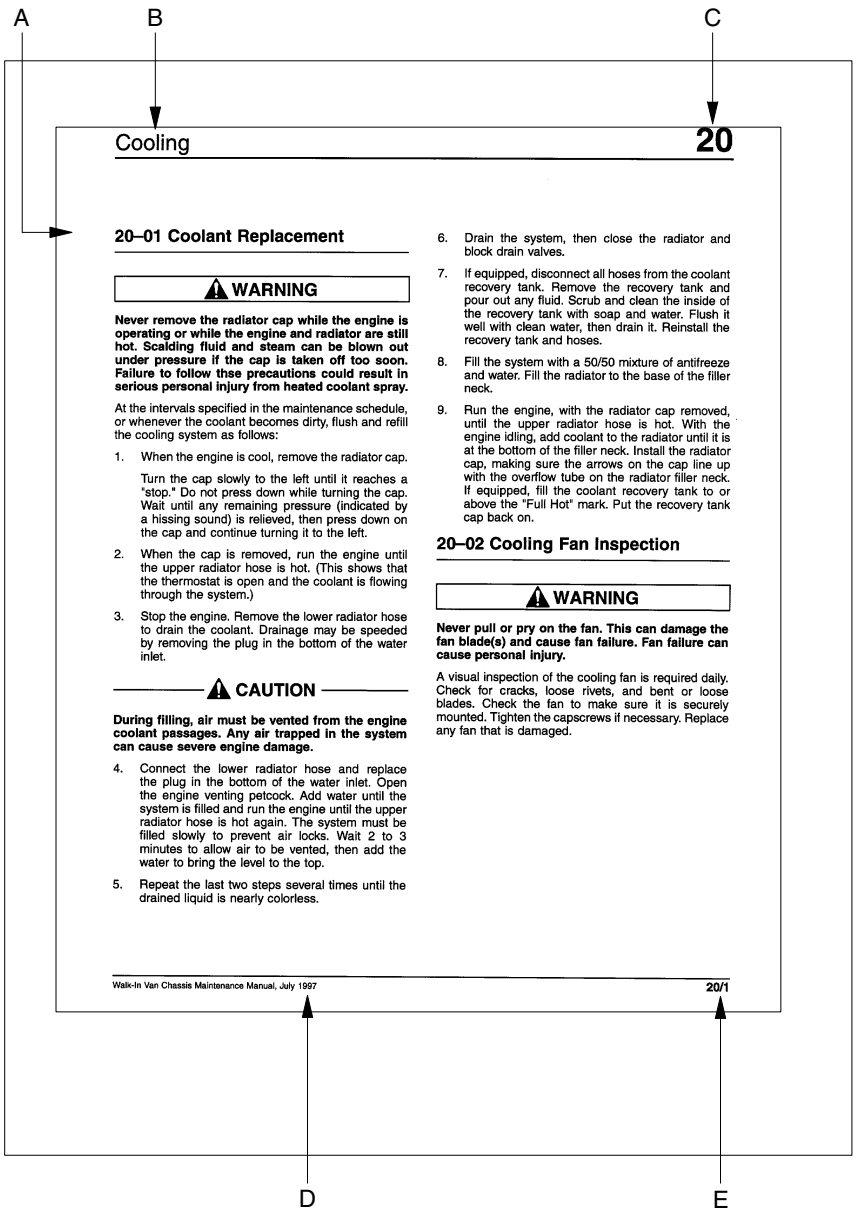
Warranty-related service information available on the AccessFreightliner.com website includes the following documentation.

Recall Campaigns Recall campaigns cover situations that involve service work or replacement of parts in connection with a recall notice. These campaigns pertain to matters of vehicle safety. All recall campaigns are distributed to dealers; customers receive notices that apply to their vehicles.

Field Service Campaigns Field service campaigns are concerned with non-safety-related service work or replacement of parts. All field service campaigns are distributed to dealers; customers receive notices that apply to their vehicles.

Page Description

For a page example of a Maintenance Manual page, see **Fig. 1**.


A
B
C
Cooling
20
20–01 Coolant Replacement
WARNING
Never remove the radiator cap while the engine is operating or while the engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if the cap is taken off too soon. Failure to follow these precautions could result in serious personal injury from heated coolant spray.
At the intervals specified in the maintenance schedule, or whenever the coolant becomes dirty, flush and refill the cooling system as follows:
1. When the engine is cool, remove the radiator cap.
Turn the cap slowly to the left until it reaches a "stop." Do not press down while turning the cap. Wait until any remaining pressure (indicated by a hissing sound) is relieved, then press down on the cap and continue turning it to the left.
2. When the cap is removed, run the engine until the upper radiator hose is hot. (This shows that the thermostat is open and the coolant is flowing through the system.)
3. Stop the engine. Remove the lower radiator hose to drain the coolant. Drainage may be speeded by removing the plug in the bottom of the water inlet.
CAUTION
During filling, air must be vented from the engine coolant passages. Any air trapped in the system can cause severe engine damage.
4. Connect the lower radiator hose and replace the plug in the bottom of the water inlet. Open the engine venting petcock. Add water until the system is filled and run the engine until the upper radiator hose is hot again. The system must be filled slowly to prevent air locks. Wait 2 to 3 minutes to allow air to be vented, then add the water to bring the level to the top.
5. Repeat the last two steps several times until the drained liquid is nearly colorless.
6. Drain the system, then close the radiator and block drain valves.
7. If equipped, disconnect all hoses from the coolant recovery tank. Remove the recovery tank and pour out any fluid. Scrub and clean the inside of the recovery tank with soap and water. Flush it well with clean water, then drain it. Reinstall the recovery tank and hoses.
8. Fill the system with a 50/50 mixture of antifreeze and water. Fill the radiator to the base of the filler neck.
9. Run the engine, with the radiator cap removed, until the upper radiator hose is hot. With the engine idling, add coolant to the radiator until it is at the bottom of the filler neck. Install the radiator cap, making sure the arrows on the cap line up with the overflow tube on the radiator filler neck. If equipped, fill the coolant recovery tank to or above the "Full Hot" mark. Put the recovery tank cap back on.
20–02 Cooling Fan Inspection
WARNING
Never pull or pry on the fan. This can damage the fan blade(s) and cause fan failure. Fan failure can cause personal injury.
A visual inspection of the cooling fan is required daily. Check for cracks, loose rivets, and bent or loose blades. Check the fan to make sure it is securely mounted. Tighten the capscrews if necessary. Replace any fan that is damaged.
Walk-In Van Chassis Maintenance Manual, July 1997
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E

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A. Maintenance Operation Number consists of the Group Number followed by the Sequence Number
B. Group Title
C. Group Number
D. Release Date
E. Group Number/Page Number

Fig. 1, Example of a Maintenance Manual Page

Maintenance Manual Contents

Group No.	Group Title
00	General Information
01	Engine
09	Air Intake
15	Alternators and Starters
20	Engine Cooling/Radiator
26	Transmission
31	Frame and Frame Components
32	Suspension
33	Front Axle
35	Rear Axle
40	Wheels and Tires
41	Driveline
42	Brakes
46	Steering
47	Fuel
49	Exhaust
54	Electrical, Instruments, and Controls

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
General Maintenance Schedule Information	00–01
Noise Emission Controls Maintenance	00–03
Vehicle Maintenance Schedule Table	00–02
Verification of Inspections Log	00–04

General Maintenance Schedule Information

Performing regular maintenance on your vehicle will help ensure that your vehicle delivers safe reliable service and optimum performance for years to come. Failure to follow a regular maintenance program can result in inefficient operation and unscheduled down time.

When the vehicle reaches the distance given for a maintenance interval, see the Vehicle Maintenance Schedule Table for a list of the maintenance operations to be performed at that maintenance interval. Use the maintenance operation reference numbers to find detailed instructions in the manual for each operation.

NOTE: Maintenance instructions in this manual are based on average vehicle use and normal operating conditions. Unusual vehicle operating conditions may require service at more frequent intervals.

For specific engine maintenance information, see the Cummins or Mercedes-Benz Operation and Maintenance Manual.

IMPORTANT: Maintenance operations appearing in italics in the following table are for noise emission control components. Numbers in the table are reference numbers matching those in the text of this manual.

Vehicle Maintenance Schedule Table: 00–02

Vehicle Maintenance Schedule																					
Maintenance Operation Number and Description	**Maintenance Interval in Miles x 1000**																				
	5	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**
	Maintenance Interval in Kilometers x 1000																				
	8	**16**	**24**	**32**	**40**	**48**	**56**	**64**	**72**	**80**	**88**	**96**	**104**	**112**	**120**	**128**	**136**	**144**	**152**	**160**
01–01 Engine-Support Fasteners Checking	•				•					•					•					•
01–02 Engine Drive Belt Inspecting	•				•					•					•					•
01–03 Engine Oil Checking and Changing, Gasoline Engines	Replace the engine oil every 3000 miles (4827 km).																				
01–04 Spark Plugs and Wires Inspecting and Replacing, Gasoline Engines	Inspect the spark plugs and wires every 12 months. Replace spark plugs and wires every 100,000 miles (160 900 km).																				
01–05 Evaporative Control System Inspecting, Gasoline Engines		•		•		•		•		•		•		•		•		•		•
09–01 Air Cleaner Element Inspecting and Replacing	Inspect the air filter every six months. Replace the air filter every 12 months, or when filter restriction reaches 25 inH_20 for diesel engines OR when the air restriction indicator is completely red for gasoline engines (if equipped with an air restriction indicator).																				
09–02 Air Cleaner Filter Minder Gauge Checking, Diesel Engines	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
09–03 Air Intake System Inspecting	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
09–04 Charge Air Cooler Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
13–01 Air Compressor Inspection		•		•		•		•		•		•		•		•		•		•
15–01 Alternator, Battery, and Starter Connections Check	•				•					•					•					•
20–01 Coolant Replacement							•							•						
20–02 *Cooling Fan Inspection (Noise Emission Control)*	•				•					•					•					•
20–03 Coolant Heater Check, Webasto	Inspect the coolant heater every 12 months.																				
26–01 Transmission Breather Checking	•		•			•			•			•			•			•		
26–02 Allison Transmission Fluid Level Checking	For fluid level check intervals, see the applicable Allison Operator's Manual.																				
26–03 Allison Transmission Fluid and Filter Changing	For oil and filter change intervals, see the applicable Allison Operator's Manual.																				
26–04 Hydraulic Hybrid Maintenance Operations	Contact Parker Hannifin at 1-866-858-5600 for instructions concerning all hydraulic hybrid maintenance items listed under this heading.																				
31–01 Interlube Chassis Lubrication System Inspecting	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
32–01 Suspension Inspecting	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
32–02 Freightliner Suspension Inspecting	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
32–03 Component Inspecting and Operation Checking, Freightliner AirLiner	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Vehicle Maintenance Schedule Table: 00–02

Vehicle Maintenance Schedule																				
Maintenance Operation Number and Description	**Maintenance Interval in Miles x 1000**																			
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	Maintenance Interval in Kilometers x 1000																			
	8	**16**	**24**	**32**	**40**	**48**	**56**	**64**	**72**	**80**	**88**	**96**	**104**	**112**	**120**	**128**	**136**	**144**	**152**	**160**
32–04 Suspension U-Bolt Torque Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
33–01 Grease-Lubricated Wheel Bearing Cleaning, Inspecting, Repacking, and Adjusting, Front Axle					•					•					•					•
33–02 Knuckle Pin Lubricating*	•				•					•					•					•
33–03 Tie-Rod End Lubricating and Inspecting†	Lubricate twice each month. Lubricate the tie-rod ends each time the chassis is power-washed.																			
33–04 All-Axle Alignment Checking	•									•										
33–05 Oil-Filled Hubs Oil Level Checking	•	•	•	•		•	•	•	•		•	•	•	•		•	•	•	•	
33–06 Oil-Filled Hubs Oil Changing					•					•					•					•
35–01 Axle Lubricant Changing	For Detroit™ rear axles with petroleum-based oil, change the lubricant every 100,000 miles (160 900 km) or every 12 months, whichever comes first; if synthetic oil is used, change the lubricant every 250,000 miles (402 250 km) or every 36 months, whichever comes first. For Meritor rear axles with petroleum-based oil, change the lubricant at 100,000 miles (160 900 km) or at 12 months of service, whichever comes first, and every 24 months thereafter; if synthetic oil is used, change the lubricant every 250,000 miles (402 250 km) or every 36 months, whichever comes first.																			
35–02 Axle Lubricant Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
35–03 Axle Breather Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
40–01 Wheel Nut Checking‡	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
41–01 Driveline Inspection and Lubrication	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
42–01 Bendix Hydro-Max® Brake System Inspection	•				•					•					•					•
42–02 Brake Lines Check, Hydraulic Disc Brakes	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
42–03 Brake Lining Wear Check, Hydraulic Disc Brakes§	•				•					•					•					•
42–04 Brake Caliper Slide Pin Lubrication, Bosch Brakes	No specific lubrication interval. See the *Bosch Pin Slide Disc Brakes Service Manual* for more information.																			
42–05 Brake Inspection	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
42–06 Slack Adjuster Lubrication	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
42–07 Air Dryer Desiccant and Coalescent Filter Replacement	Replace the Bendix AD9 filter and the Haldex PURest air dryer filter kit every 36 months.																			
42–08 Air Dryer Check	Perform the air dryer check every six months.																			
42–09 Versajust Slack Adjuster Inspection and Lubrication	Complete this procedure every 25,000 miles (40 225 km), 3 months, or 500 operating hours, whichever comes first.																			

Vehicle Maintenance Schedule Table: 00–02

Vehicle Maintenance Schedule																					
Maintenance Operation Number and Description	**Maintenance Interval in Miles x 1000**																				
	5	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**
	Maintenance Interval in Kilometers x 1000																				
	8	**16**	**24**	**32**	**40**	**48**	**56**	**64**	**72**	**80**	**88**	**96**	**104**	**112**	**120**	**128**	**136**	**144**	**152**	**160**
46–01 Drag Link Lubricating	Lubricate twice each month. Lubricate the drag link ends each time the chassis is power-washed.																				
46–02 Power Steering Hose Checking	•				•					•					•					•
46–03 Steering Driveline Lubricating	•				•					•					•					•
46–04 Steering Gear Bolts Torque Checking	•									•										•
46–05 Power Steering Reservoir Fluid and Filter Changing																				•
47–01 CNG High-Pressure Fuel Filter Replacement	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
47–02 CNG Fuel Leak Test	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
47–03 CNG High-Pressure Fuel Filter Draining	Drain the high-pressure fuel filter every 2500 miles (4023 km).																				
47–04 CNG Fuel Block Housing Draining					•					•					•					•
47–05 CNG Low-Pressure Fuel Filter Replacement					•					•					•					•
47–06 CNG Low-Pressure Fuel Filter Draining	•	•	•	•		•	•	•	•		•	•	•	•		•	•	•	•	
47–07 CNG Fuel Tank Visual Inspection	Inspect the fuel tank every 25,000 miles (40 225 km) OR every 6 months, whichever comes first. The fuel tank must be replaced every 15 years.																				
47–08 Diesel Fuel Filter Replacement		•		•		•		•		•		•		•		•		•		•
47–09 Gasoline Fuel Filter Replacement	Replace the fuel filter every five years or 150,000 miles (241 350 km), whichever comes first.																				
47–10 Fuel Tank and Line Inspection, Propane Engine						•						•						•		
47–11 Fuel Rail Fitting and Injector Inspection, Propane Engine						•						•						•		
47–12 Fuel Filter Replacement, Propane Engine						•						•						•		
49–01 *Exhaust System Inspecting (Noise Emission Control)*			•			•			•			•			•			•		
54–01 Lighting System Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
54–02 Battery, Battery Box, and Cable Checking and Cleaning	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
54–03 Ground Cables Checking and Cleaning	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
54–04 Electrical System Checking	•				•					•					•					•

Vehicle Maintenance Schedule Table: 00–02

Vehicle Maintenance Schedule																				
Maintenance Operation Number and Description	Maintenance Interval in Miles x 1000																			
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	Maintenance Interval in Kilometers x 1000																			
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144	152	160
54–05 Battery Voltage Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

* Lubricate knuckle pins at first 5000 miles (8000 km); thereafter, at indicated intervals OR every 12 months, whichever comes first. For vehicles with Detroit axles, complete this procedure once a year or every 5000 miles (8000 km), whichever comes first.

† For vehicles with Detroit axles, complete this procedure once per year or at 5000 miles (8000 km), whichever comes first.

‡ Wheel nuts must be retightened to torque specifications at 50 and 500 miles (80 and 900 km), OR at new vehicle operation, and at any wheel change or any time the nuts have been loosened; thereafter, at indicated intervals.

§ Check brake lining at first 5,000 miles (8045 km); thereafter, at indicated intervals OR every 12 months, whichever comes first.

Table 1, Vehicle Maintenance Schedule

Noise Emission Controls Maintenance

Federal Law, Part 205: Transportation Equipment Noise Emission Controls

Part 205, Transportation Equipment Noise Emission Controls, requires the vehicle manufacturer to furnish, with each new vehicle, such written instructions for the proper maintenance, use, and repair of the vehicle by the ultimate purchaser to provide reasonable assurance of the elimination or minimization of noise-emission-control degradation throughout the life of the vehicle. In compliance with the law, the noise emission controls maintenance information in each applicable group of this manual, in conjunction with the vehicle workshop manual, provides these instructions to owners.

Recommendations for Replacement Parts

Replacement parts used for maintenance or repair of noise emission controls should be genuine Freightliner Custom Chassis Corporation (FCCC) parts. If other than genuine FCCC parts are used for replacement or repair of components affecting noise emission control, the owner should be sure that such parts are warranted by their manufacturer to be equivalent to genuine FCCC parts in performance and durability.

Freightliner Noise Emission Controls Warranty

See the vehicle owner's warranty information book for warranty information concerning noise emission controls.

Tampering With Noise Controls is Prohibited

Federal law prohibits the following acts or the causing thereof:

1. The removal or rendering inoperative by any person (other than for purposes of maintenance, repair, or replacement) of any device or element of design incorporated into any new vehicle for the purpose of noise control, prior to its sale or delivery to the ultimate purchaser, or while it is in use.
2. The use of the vehicle after such device or element of design has been removed or rendered inoperative by any person.

   Among those acts presumed to constitute tampering are the acts listed below:

   A. Removal of, or rendering inoperative, the engine speed governor so as to allow engine speed to exceed manufacturer's specifications.

   B. Removal of, or rendering inoperative, the fan clutch, including bypassing the control on any thermostatic fan drive to cause it to operate continuously.

   C. Removal of the fan shroud.

   D. Removal of, or rendering inoperative, exhaust components, including exhaust pipe clamping.

   E. Removal of air intake components.

Maintenance Instructions

Scheduled intervals are in the maintenance table in this group. A "Verification of Inspections Log (Groups 20 and 49)" follows, and should be filled in each time noise emission controls on the vehicle are maintained or repaired.

Verification of Inspections Log

Verification of Inspections Log, Groups 20 and 49				
Date	**Mileage**	**Item**	**Cost**	**Maintenance Facility**
Group 20 — Fan Clutch				
Group 49 — Exhaust System Components				

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Engine Drive Belt Inspecting	01–02
Engine Oil Checking and Changing, Gasoline Engines	01–03
Engine-Support Fasteners Checking	01–01
Evaporative Control System Inspecting, Gasoline Engines	01–05
Safety Precautions	01–00
Spark Plugs and Wires Inspecting and Replacing, Gasoline Engines	01–04

01–00 Safety Precautions

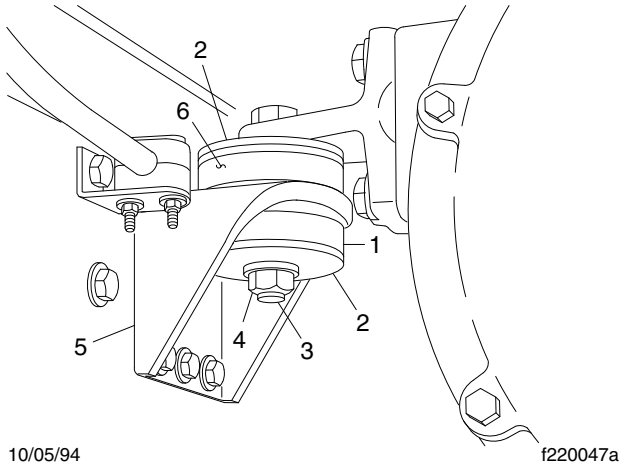
Saftey Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

01–01 Engine-Support Fasteners Checking

Check the front and the rear engine-support fasteners for tightness. See **Fig. 1**. See **Chapter 15** of the *Walk-In Van Chassis Operator's Manual* for torque specifications, or take the vehicle to an authorized Freightliner dealer.



1. Lower Isolator
2. Engine Support Washer
3. Capscrew
4. Hexnut
5. Engine Mount
6. Upper Isolator

Fig. 1, Engine Mount (rear)

01–02 Engine Drive Belt Inspecting

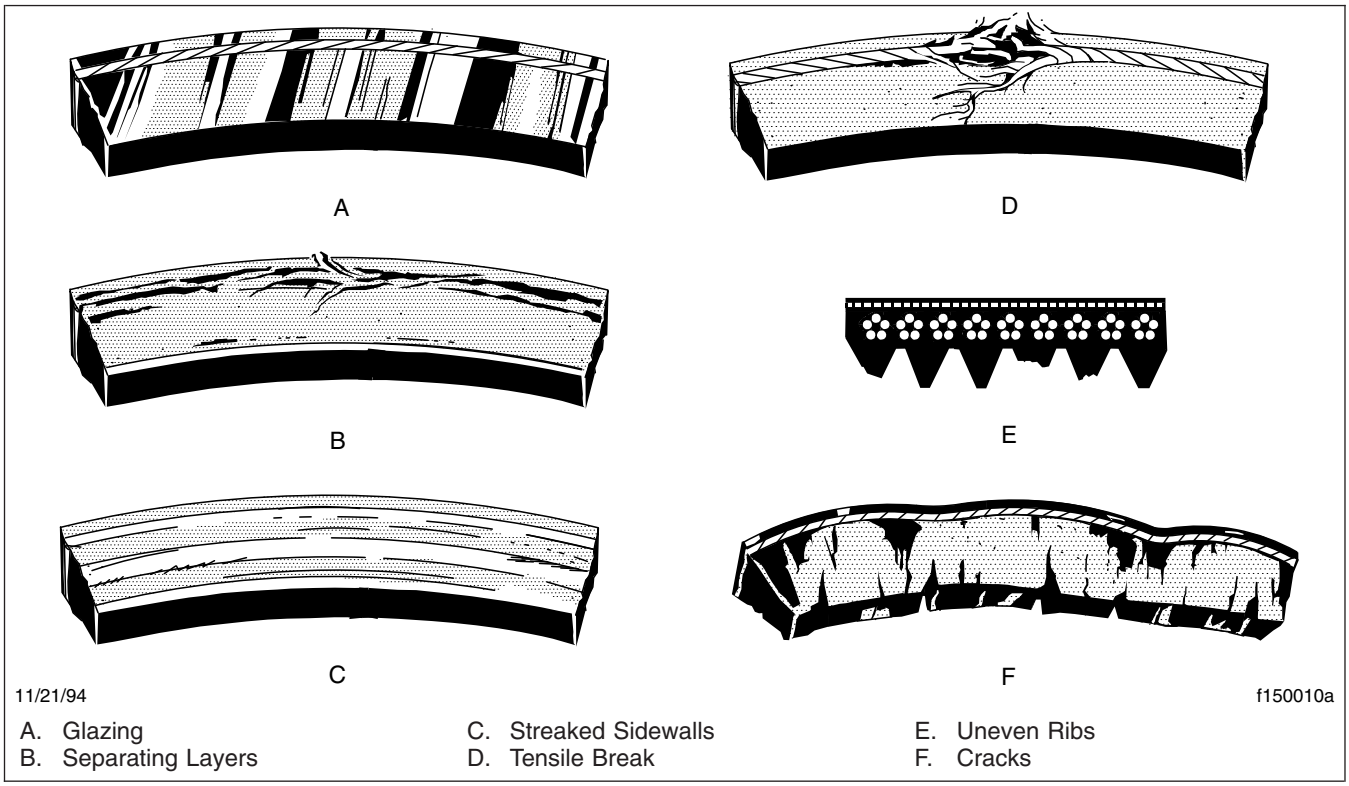
⚠ WARNING

The engine and the belt must be cool before you check the belt. Handling a hot belt can cause personal injury.

Worn or loose drive belts may cause premature bearing failure or engine overheating. Excessive tension, or too little tension on the belt may result in excessive and premature belt wear. Poly-V belts, or serpentine belts, are retained by a belt tensioner that requires no tension adjustment. Replace the engine drive belt if any conditions described in the visual description are found. V-belts are installed as individual belts, and as matched sets. When replacing a matched set of belts, always replace both belts at the same time. Matched belts must be from the same manufacturer. To inspect a belt, gently twist the belt to view the belt sidewalls and bottom. Visually inspect all drive belts for the following conditions, then perform the belt tension inspection.

Visual Inspection

1. Inspect the belt for glazing. See **Fig. 2**, Ref. A. Glazing is represented by shiny sidewalls, and is caused by friction created when a loose belt slips in the pulleys. It can also be caused by oil or grease contamination on the pulleys.
2. Check the belt for ply separation. See **Fig. 2**, Ref. B. Oil, grease, or belt dressing can cause the belt to fall apart in layers. Repair any oil or coolant leaks that are affecting the belts before replacing the drive belts. Do not use belt dressing on any belt.
3. Check the belt for a jagged or streaked sidewall. See **Fig. 2**, Ref. C. Jagged or streaked sidewalls are the result of foreign objects, such as sand or gravel in the pulley, or a rough pulley surface.
4. Check for tensile breaks (breaks in the cord body). See **Fig. 2**, Ref. D. Cuts in a belt are usually caused by foreign objects in the pulley, or by prying or forcing the belt during removal or installation.
5. Check for uneven ribs on serpentine (poly-V) belts. See **Fig. 2**, Ref. E. Foreign objects in the



A. Glazing
B. Separating Layers
C. Streaked Sidewalls
D. Tensile Break
E. Uneven Ribs
F. Cracks

Fig. 2, Drive Belt Replacement Conditions

pulley will erode the undercord ribs, causing the belt to lose its gripping power.

6. Check the drive belts for cracks. See **Fig. 2**, Ref. F. Small irregular cracks are usually the signs of an old belt.
7. Visually inspect the pulleys for excessive play or wobble. Excessive play or wobble indicates a failure of the pulley bearing. Check for belt squealing or squeaking. Replace the bearings as necessary.

NOTE: If it is difficult to distinguish the location of a supposed bearing noise, obtain a stethoscope and place it on the component being checked, not the pulley, to isolate the area from outside interference.

8. Inspect all pulleys for foreign objects, oil, or grease in the grooves.

Belt Tension Inspection

Spring-Tension Type

On belts equipped with a spring tensioner, the belt tension is automatically adjusted. Check that the tensioner is holding tension on the belt by inserting the end of a breaker bar in the 1/2-inch square hole on the forward face of the tensioner, and rotating the tensioner down, away from the belt. When the breaker bar is slowly released, the tensioner should return to its original position.

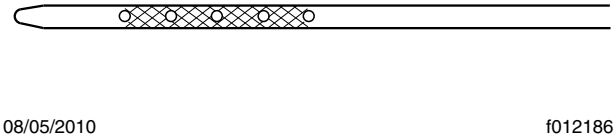
01–03 Engine Oil Checking and Changing, Gasoline Engines

Checking

It is important to check the oil regularly and keep it at the proper level. In order to get an accurate reading,

the oil must be warm and the vehicle must be on level ground.

1. Turn off the engine and give the oil several minutes to drain back into the oil pan. If this is not done, the oil dipstick may not show the actual level.
2. Pull out the dipstick and clean it with a paper towel or cloth, then push the dipstick back in all the way. Remove it again, keeping the tip down, and check the level.
3. If the oil is below the cross-hatched area at the tip of the dipstick, add at least one quart (liter) of the recommended oil. See **Fig. 3**.



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NOTE: Oil should be within the cross-hatched area of the dipstick.

Fig. 3, Oil Dipstick

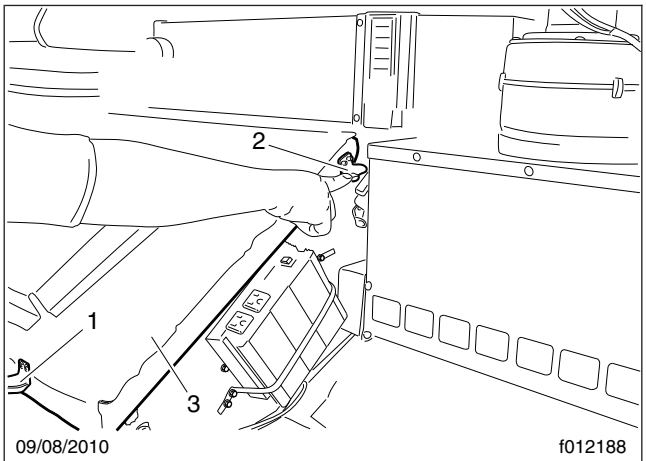
Changing

1. Park the vehicle on a level surface, apply the park brake, and shutdown the engine.
2. Place a drain pan under the oil pan.
3. Remove the oil drain plug and let the oil drain into the drain pan.
4. Clean the drain plug and set aside.
5. Remove the oil filter and clean the rim of the oil filter housing.
6. Lubricate the O-ring of the new oil filter, then install the oil filter. Tighten the filter by hand until snug, being careful not to overtighten.
7. Install the oil drain plug. Tighten the plug 18 lbf·ft (24 N·m).
8. Fill the engine with 6 quarts (5.6 L) of oil.
9. Pull out the dipstick, clean it and put the dipstick all the way back in. Remove the dipstick again to check that the correct amount of oil has been added.

01–04 Spark Plugs and Wires Inspecting and Replacing, Gasoline Engines

Visual Inspection

1. Lift the four latches and remove the engine access cover. See **Fig. 4**.



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1. Bottom Latch (two latches at the front)
2. Top Latch (one on each side)
3. Access Cover

Fig. 4, Engine Access Cover

2. Inspect the spark plug wires for cracks and chaffing.
3. If the spark plug wires need to be replaced, see the instructions under **Replacement**. If replacement is not needed, install the engine access cover and lock the four latches.

Replacement

IMPORTANT: When replacing spark plugs and wires, remove and replace one plug and wire at a time. This will eliminate the possibility of incorrectly installing the wires and having a misfire issue.

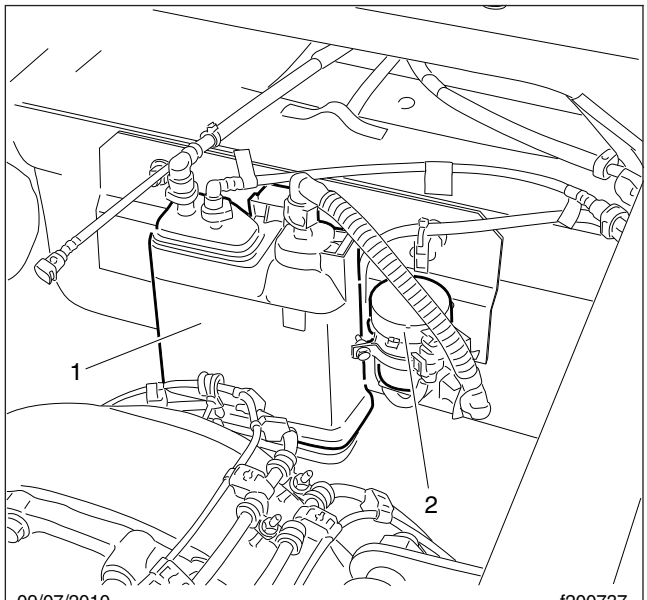
1. Hold both ends of the spark plug wire, and gently pull one end of the wire off at a time.

NOTE: Do not discard the insulation shields. The shields will be needed for the new wires.

2. Use a spark plug socket, a 3-inch extension, and ratchet to remove the spark plug.
3. Install the new spark plug(s) and tighten just until snug.
4. Take a new spark plug wire and put the insulation shield at the plug-end of the wire.
5. Put a small amount of dielectric grease on each end of the spark plug wire electrode, then install the wire.
6. Repeat the above steps for the remaining spark plugs and wires.
7. Install the engine access cover and lock the four latches.

01–05 Evaporative Control System Inspecting, Gasoline Engines

Inspect the solenoid, evaporative control system canister, and lines. See **Fig. 5**. Look for damaged lines, leaking fuel, or any damage to the canister itself. Make certain the electrical connections are properly connected.



1. Evaporative Control System Canister
2. Solenoid

Fig. 5, Evaporative Control System

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Air Cleaner Element Inspecting and Replacing	09–01
Air Cleaner Filter Minder Gauge Checking, Diesel Engines	09–02
Air Intake System Inspecting	09–03
Charge Air Cooler Checking	09–04
Safety Precautions	09–00

09–00 Safety Precautions

Saftey Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

09–01 Air Cleaner Element Inspecting and Replacing

NOTICE

All air intake components and connections must be air- and water-tight. Dirt or dust entering the engine can cause internal engine damage. Most of the dirt and dust particles are silicates, which fuse into abrasive glass-like particles when exposed to engine combustion. These particles can grind piston rings, pistons, and cylinder liners. Do not operate the engine with the air filter element or any air intake component removed.

IMPORTANT: Due to the variety of possible driving conditions (dirt roads, paved roads, etc.), it is critical to check the air restriction indicator, if so equipped. If the vehicle is not equipped with an air restriction indicator, inspect all components of the air intake system and air filter every six months. Replace the air filter every 12 months, or when filter restriction reaches 25 inH_2O for diesel engines, or when the air restriction indicator is completely red for gasoline engines (if equipped with an air restriction indicator). **More frequent inspections and/or filter replacement may be needed if the vehicle is being operated in a dusty environment, to avoid damaging the vehicle.**

Inspecting

NOTICE

Use the air intake restriction gauge rather than visual inspection to determine if servicing the air filter element is necessary. Removal of the air filter element can cause damage to the primary seal, which may allow contaminants into the engine, potentially causing engine damage.

IMPORTANT: Removal and visual inspection of the air filter should only occur if the vehicle is not equipped with an air restriction indicator.

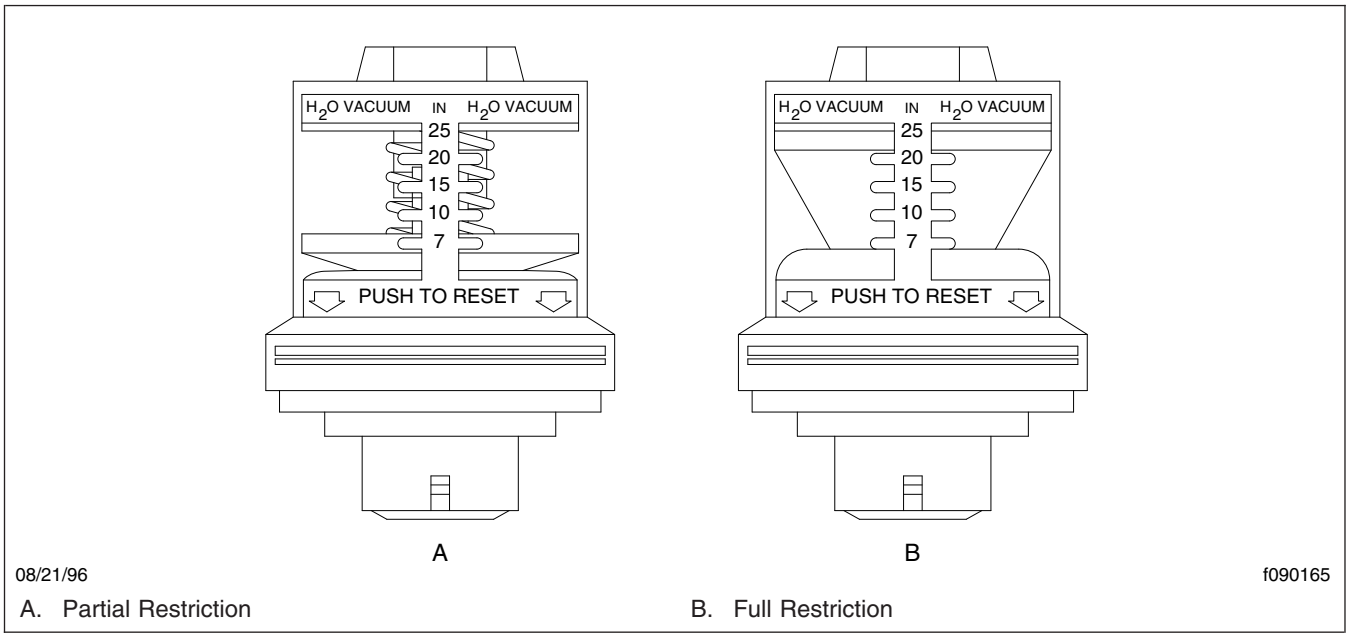
Remove and visually inspect the air filter for holes, tears, cracks, or other damage at the recommended interval. Remove loose debris, such as leaves or pine needles, from the filter housing. If the air filter is damaged, replace it. See **Group 09** of the *Walk-In Van Workshop Manual* for removal and installation instructions, or take the vehicle to an authorized Freightliner dealer.

Engine damage can occur if the air intake system is not properly maintained. Use the air intake restriction indicator to check for air intake system damage or leaks. See **Fig. 1** and **Fig. 2**. Make sure the engine is off and note the existing reading on the indicator. Reset the indicator by pushing it down. See **Fig. 1** and **Fig. 2**. Start the engine and take a short test drive. Check the indicator again and note the level of restriction on the indicator. A decrease from the previous level of restriction or a very low air restriction indicator reading (0 to 4 inH_2O) could indicate an air intake system problem such as a damaged air filter, loose or disconnected air intake piping, or a disconnected or damaged air restriction indicator.

Replacing

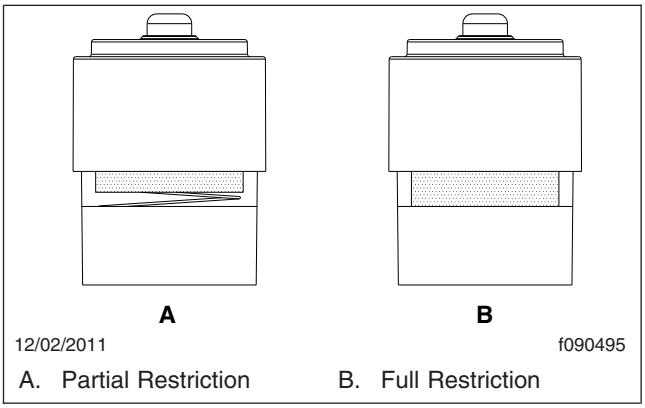
NOTICE

Do not use aftermarket air-cleaner elements. Aftermarket air-cleaner elements may not seal the housing correctly, which can lead to engine damage and potentially the loss of warranty. When replacing an air-cleaner element, use only the part listed in PartsPro for the serial number of the vehicle.



A. Partial Restriction B. Full Restriction

Fig. 1, Air Restriction Indicator, Diesel Engines



A. Partial Restriction B. Full Restriction

Fig. 2, Air Restriction Indicator, Gasoline Engines

NOTICE

Do not clean or reuse the air filter. Cleaning and reusing the the air filter increases the chances of dirt entering the engine. Always replace with a new air filter.

Replace the air filter every 12 months, or when filter restriction reaches 25 inH_2O for diesel engines, or when the air restriction indicator is completely red for gasoline engines (if equipped with an air restriction indicator). See **Group 09** of the *Walk-In Van Workshop Manual* for removal and installation instructions, or take the vehicle to an authorized Freightliner dealer.

09–02 Air Cleaner Filter Minder Gauge Checking, Diesel Engines

The filter minder gauge measures the amount of air restriction (in inches or millimeters of water vacuum) in the air intake system. It is connected to the air intake tube by a vacuum hose and a small vacuum filter. The gauge takes its measurements when the engine is running at full load, and then locks in place until reset. See **Fig. 1** for depictions of how the gauge appears when the air intake is partially restricted and when it is fully restricted and should be replaced.

09–03 Air Intake System Inspecting

Check the air intake system for damaged or cracked hoses, and for loose clamps. Also check the air filter.

09–04 Charge Air Cooler Checking

Good airflow through the radiator and charge air cooler core is essential for proper engine cooling. The cores allow air passage, but form a barrier that tends to collect insects and airborne debris.

If the charge air cooler core fins are bent, use a small pair of needle-nose pliers or a small screwdriver to straighten them. If the fins are clogged, use compressed air or water directed from the fan side of the radiator core to backflush any material restricting airflow.

Ensure that the hoses are not chafing and that the system is closed with no air leaks.

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Title of Maintenance Operation (MOP)	MOP Number
Air Compressor Inspection	13–01
Safety Precautions	13–00

13–00 Safety Precautions

Saftey Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

13–01 Air Compressor Inspection

1. Inspect the air compressor intake hoses and connections at the air intake and air compressor for physical damage. If needed, change the hoses, and/or tighten or replace the connections.
2. Inspect the coolant supply and return lines for tight connections. Tighten the connections and replace the lines and fasteners if needed.
3. For the air governor, inspect the piping and connections for leaks. Replace gaskets and faulty components as needed.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Alternator, Battery, and Starter Connections Check	15–01
Safety Precautions	15–00

15–00 Safety Precautions

Saftey Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

15–01 Alternator, Battery, and Starter Connections Check

⚠ WARNING

Batteries release explosive gas as a by-product of their chemical activity. Do not smoke when working around batteries. Put out all flames and remove any source of sparks or intense heat. Make sure the battery compartment is completely vented before disconnecting or connecting the battery cables.

Battery acid is extremely harmful if splashed in the eyes or on the skin. Always wear a face shield and protective clothing when working around batteries.

Damaged, chafed, or kinked wiring can cause electrical short-circuits and lead to fires, causing property damage, injury, or death. Clean, inspect, and maintain wiring and connections carefully.

1. Disconnect the batteries.
2. Check the tightness of the alternator bracket fasteners and alternator mounting fasteners; tighten the fasteners as needed. For torque values, see **Group 15** of the vehicle *Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
3. Check that all electrical connections at the alternator and starter are clean. Clean and tighten all charging system electrical connections as needed. Spray each electrical connection at the alternator and starter with dielectric red enamel.

   Trace and inspect all wiring and cables connected to:

   - alternator
   - starter and depopulation studs
   - batteries
   - magnetic switch
   - cab
   - jump-start studs
   - battery isolation relays
   - battery shutoff switches
4. Check wires and cables for wear, chafing, kinks, discolored insulation, or loose clamps or ties. Find the cause of any problems and repair, replace, and reroute wires and clamps as necessary.

IMPORTANT: Ensure that wires and cables are not near any heat sources; if they are, reroute them.

5. Clean all circuit breakers and relays.
6. Check the alternator wiring for missing insulation, kinks, and heat damage. Replace or repair as needed.
7. On the bundled cable that runs from the batteries to the starter, ensure that tie straps are installed at least every 12 inches (30 cm). Replace any missing tie straps, and add tie straps where spacing between them exceeds 12 inches (30 cm).
8. Ensure that all cables have sufficient slack to allow for engine movement, and that there is no force on any wiring connectors.
9. If any convoluted tubing is damaged, check the wiring inside it. Replace any damaged or missing convoluted tubing.
10. Inspect the battery cables for wear, and replace as needed. Clean the cable connector terminals with a wire brush. See **Group 54** of the vehicle *Workshop Manual* for troubleshooting instructions, and for adjustment, repair, or replacement instructions, or take the vehicle to an authorized Freightliner dealer.

    10.1 Clean and tighten the battery ground cable, terminal, and clamps.

10.2 Inspect the retainer assembly (or battery hold-downs) and the battery box. Replace worn or damaged parts. Remove any corrosion with a wire brush, and wash with a weak solution of baking soda and water. Rinse with clean water, then dry. Paint the retainer assembly, if needed, to prevent rusting.

10.3 Check that foreign objects, such as stones, bolts, and nuts, are removed from the battery box.

10.4 After cleaning, connect the cables to the batteries, and tighten them to the torque specifications listed on the battery, generally 10 to 15 lbf·ft (14 to 20 N·m).

10.5 Coat the battery terminals with dielectric grease.

11. Check the terminals on the battery shut-off switch and the starter relay. Make sure that the terminal connections are clean and tight. Coat the terminal connections with dielectric red enamel after cleaning.

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Title of Maintenance Operation (MOP)	MOP Number
Coolant Heater Check, Webasto	20–03
Coolant Replacement	20–01
Cooling Fan Inspection	20–02
Safety Precautions	20–00

20–00 Safety Precautions

Saftey Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

20–01 Coolant Replacement

At the intervals specified in the maintenance schedule, or whenever the coolant becomes dirty, flush and refill the cooling system as follows, based on the type of engine installed in the vehicle.

Diesel Engine

⚠ WARNING

Never remove the surge tank cap while the engine is operating or while the engine and radiator are still hot. Scalding fluid and steam can blow out under pressure if the cap is taken off too soon. Failure to follow these precautions could result in serious personal injury from heated coolant spray.

1. When the engine is cool, remove the surge tank cap.

   Turn the cap slowly counterclockwise until it reaches a "stop." Do not press down while turning the cap. Wait until any remaining pressure (indicated by a hissing sound) is relieved, then press down on the cap and continue turning it counterclockwise.
2. When the cap is removed, run the engine until the upper radiator hose is hot. This shows that the thermostat is open and that the coolant is flowing through the system.
3. Shut down the engine. Remove the lower radiator hose and drain the coolant. Draining may be speeded up by removing the plug from the bottom of the water inlet.

NOTICE

During filling, air must be vented from the engine coolant passages. Any air trapped in the system can cause severe engine damage.

4. Connect the lower radiator hose and install the plug in the bottom of the water inlet. Add water until the system is filled and run the engine until the upper radiator hose is hot again. The system must be filled slowly to prevent air locks. Wait 2 to 3 minutes to allow air to be vented, then add water to bring the level to the top.
5. Repeat the last two steps several times until the drained liquid is nearly colorless.
6. Drain the system, then close the radiator and block the drain valves.
7. Disconnect all hoses from the coolant surge tank. Remove the surge tank and pour out any fluid. Scrub and clean the inside of the surge tank with soap and water. Flush it thoroughly with clean water, then drain it. Reinstall the surge tank and hoses.

IMPORTANT: On vehicles with EPA07-compliant engines, the coolant capacity varies depending on the engine and the accessory installation. After servicing the cooling system, always verify that the coolant level is between the MIN and MAX lines on the surge tank.

8. Using an approved coolant, fill the system with a 50/50 mixture of antifreeze and water to the base of the filler neck. See **Table 1**.

Approved Coolants

Engine Type	Coolant Manufacturer	Coolant Designation*
Diesel	Old World Industries	Fleet Charge®
	Shell	Shell HD/N Antifreeze
	Texaco	JC04 Antifreeze
	Van Waters and Rogers Ltd. (Canada)	Diesel Antifreeze No. 6038

Approved Coolants		
Engine Type	**Coolant Manufacturer**	**Coolant Designation***
Gasoline Propane	GM	GM DEX-COOL®†

* Freightliner-approved antifreeze must meet one of the following conditions: A. Ethylene glycol solution that meets GM 6038–M Engineering Standards. B. Ethylene glycol solution that has less than 0.1% anhydrous sodium metasilicate and meets either GM 1825–M or GM 1899–M Engineering Standards.

† GM DEX-COOL is approved for use in gasoline and propane engines only.

Table 1, Approved Coolants

9. With the surge tank cap removed, start the engine and run it at low idle for 60 seconds. Increase engine speed to 1200 rpm for 60 seconds, then decrease engine speed to low idle for 60 seconds. Top off the coolant level to the MAX line on the surge tank. Install the surge tank cap, making sure that the arrows on the cap line up with the overflow tube on the surge tank. Shut down the engine.

Alternative Fuel Engine, 6.0 L

Refer to **Fig. 1** when performing the following procedure.

⚠ WARNING

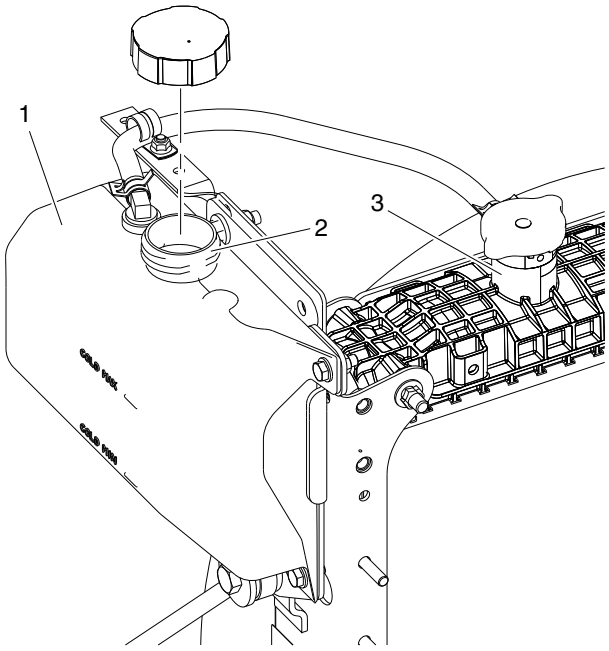
Never remove the radiator cap while the engine is operating or while the engine and radiator are still hot. Scalding fluid and steam can blow out under pressure if the cap is taken off too soon. Failure to follow these precautions could result in serious personal injury from heated coolant spray.

1. When the engine is cool, remove the radiator cap.

   Turn the cap slowly counterclockwise until it reaches a "stop." Do not press down while turning the cap. Wait until any remaining pressure (indicated by a hissing sound) is relieved, then press down on the cap and continue turning it counterclockwise.

2. When the cap is removed, run the engine until the upper radiator hose is hot. This shows that the thermostat is open and that the coolant is flowing through the system.

3. Shut down the engine. Remove the lower radiator hose and drain the coolant. Draining may be speeded up by removing the plug from the bottom of the water inlet.



1. Overflow Bottle
2. Overflow Bottle Fill Neck
3. Radiator Fill Neck

Fig. 1, Overflow Bottle

NOTICE

During filling, air must be vented from the engine coolant passages. Any air trapped in the system can cause severe engine damage.

NOTE: The maximum fill rate of a 6.0L engine radiator is 2 gallons per minute.

4. Connect the lower radiator hose and install the plug in the bottom of the water inlet. Add water until the system is filled and run the engine until the upper radiator hose is hot again. The system must be filled slowly to prevent air locks. Wait 2 to 3 minutes to allow air to be vented, then add water to bring the level to the top.

5. Repeat the last two steps several times until the drained liquid is nearly colorless.

6. Drain the system, then close the radiator and block the drain valves.

7. Disconnect the hose from the coolant overflow bottle. Remove the bottle and pour out any fluid. Scrub and clean the inside of the overflow bottle with soap and water. Flush it thoroughly with clean water, then drain it. Reinstall the overflow bottle and hoses.

NOTE: The maximum fill rate of a 6.0L engine radiator is 2 gallons per minute.

8. Using an approved coolant, fill the system with a 50/50 mixture of antifreeze and water to the base of the filler neck. See **Table 1**.
9. With the radiator cap removed, start the engine and run it at low idle for 60 seconds. Increase engine speed to 1200 rpm for 60 seconds, then decrease engine speed to low idle for 60 seconds. Top off the coolant level to the base of the radiator fill neck. Install the radiator cap. Fill the coolant overflow bottle to the COLD MAX line. Install the cap on the overflow bottle. Shut down the engine.

20–02 Cooling Fan Inspection

⚠ WARNING

Never pull or pry on the fan. This can damage the fan blade(s) and cause fan failure. Fan failure can cause personal injury.

A visual inspection of the cooling fan is required daily. Check for cracks, loose rivets, and bent or loose blades. Check the fan to make sure that it is securely mounted. Tighten the capscrews if necessary. Replace any fan that is damaged. Also check the fan recirculation shield, if so equipped.

20–03 Coolant Heater Check, Webasto

1. Using compressed air, clean any accumulated debris or dust from the heater and enclosure box. Inspect all components for wear or damage.
2. Check that the batteries are in good condition. If the voltage is too low or too high, the heater will automatically shut down. Check the wiring harnesses for damage. Replace the harnesses if necessary.
3. Check the air intake port for obstructions. Carefully check the air intake tube for any restrictions or damage, and repair or replace the tube if necessary.
4. Check the exhaust system for restrictions or corrosion. Replace any damaged parts.
5. Change the fuel filter, if so equipped. Inspect the fuel line for damage, restrictions, or loose connections. Repair or replace the line if it is damaged.
6. Inspect all coolant lines and clamps for leakage, restrictions, or damage. Replace the lines as needed. Inspect the coolant circulation pump for leakage. Repair or replace the pump if it is damaged.
7. Run the heater at least once a month for 10 minutes.
8. Check the water and fuel connections for leakage. Tighten the hose clamps if needed.

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26–00 Safety Precautions

Saftey Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

26–01 Transmission Breather Checking

Transmission housing breathers must remain clear. A plugged breather could result in pressure build-up, which could cause lubricant leakage.

If the breather is plugged, clean or replace it. See **Fig. 1**. Check more often if the vehicle is operating under very dusty conditions.

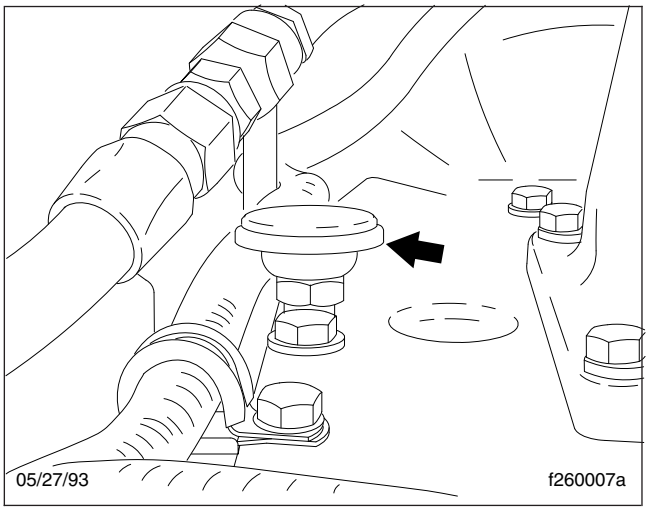


Fig. 1, Transmission Breather

26–02 Allison Transmission Fluid Level Checking

NOTICE

Operating a transmission with the fluid level higher or lower than recommended can result in transmission damage. Do not overfill the transmission. Overfilling will force fluid out of the case through the main shaft openings.

Do not mix types and brands of fluid, because of possible incompatibility. Do not use fluid additives, friction modifiers, extreme-pressure gear fluids, or multiviscosity lubricants.

IMPORTANT: For oil and filter change intervals, see the applicable Allison Operator's Manual.

Cold Check

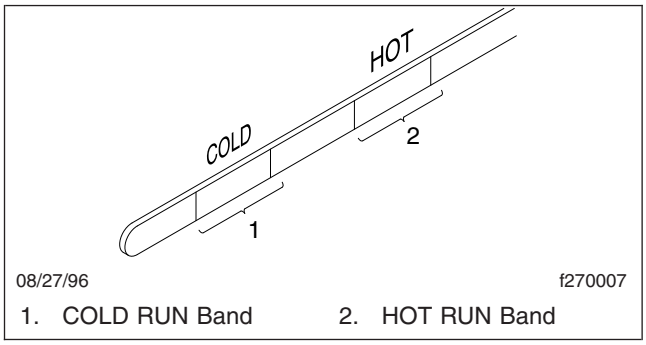
IMPORTANT: After replacing the transmission fluid or changing the filter(s), it is important to check the fluid level cold to determine if the transmission has a sufficient amount of fluid to be safely operated until a hot check can be performed.

1. A cold check may be made when the sump temperature is 60 to 104°F (15 to 40°C).
2. Run the engine for at least one minute to clear the fluid system of air.

NOTICE

Do not allow foreign matter to enter the transmission. Dirt or foreign matter in the hydraulic system may cause undue wear of transmission parts, make valves stick, and clog passages.

3. Clean all dirt away from around the end of the fluid fill tube before removing the dipstick. With the engine running, wipe the dipstick clean and check the fluid level. Any level within the COLD RUN (lower) band is satisfactory for operating the vehicle. If the level is not within the COLD RUN band, add or drain fluid until it reaches the middle of the COLD RUN band. See **Fig. 2**.
4. Perform a hot check at the first opportunity after normal operating temperature, 160 to 200°F (71 to 93°C), is reached.



1. COLD RUN Band 2. HOT RUN Band

Fig. 2, Dipstick Markings

Hot Check

1. Operate the transmission in a drive range until normal operating temperature, 160 to 200°F (71 to 93°C), is reached.

NOTE: The fluid must be warm to ensure an accurate check. The fluid level rises as temperature increases.

2. Park the vehicle. Shift to neutral (N) and apply the parking brake. Let the engine run at idle.
3. Wipe the dipstick clean and check the fluid level. A safe operating level is any level within the HOT RUN (upper) band on the dipstick. See **Fig. 2**.
4. If the fluid is not within this range, add or drain fluid as needed to bring the level to the top of the HOT RUN band. See **Table 1** for approved transmission lubricants, and **Table 2** for lubricant capacities.

26–03 Allison Transmission Fluid and Filter Changing

IMPORTANT: For oil and filter change intervals, see the applicable Allison Operator's Manual. To request a replacement Allison Operator's Manual, call 1-888-666-5799.

Oil and filter change intervals can also be found on the Allison Transmission website at **www.allisontransmission.com**. Choose "Service", and click "Service Tips". Then, select the appropriate transmission to view fluid and filter change recommendations.

26–04 Hydraulic Hybrid Maintenance Operations

IMPORTANT: Contact Parker Hannifin at 1-866-858-5600 for hydraulic hybrid maintenance instructions.

Along with the other applicable maintenance operations in this manual, perform the maintenance items listed below

- hydraulic hose and fitting inspection
- hydraulic fluid leak checking
- hydraulic fluid level and pressure checking
- hydraulic fluid and filter changing
- gearbox fluid level checking
- gearbox fluid and filter changing
- gearbox and low pressure reservoir fluid sampling
- low pressure reservoir burst disc cap inspecting
- low pressure reservoir relief valve checking

Approved Allison Transmission Lubricants*		
TES-295 Approval Number	**Company**	**Product Brand Name**
AN-051005	ExxonMobil Lubricants and Petroleum Specialties Company	Mobil Delvac Synthetic ATF
AN-011001	Castrol Heavy Duty Lubricants	TranSynd
AN-031002	BP	Autran Syn 295

Approved Allison Transmission Lubricants*		
TES-295 Approval Number	**Company**	**Product Brand Name**
AN-031003	Cognis Corporation	Emgard 2805
AN-031004	Fleetrite Synthetic ATF	
AN-071006	John Deere & Company	HD SynTran

* To check the latest Allison approved fluids, go to the Allison Transmission website at **www.allisontransmission.com**. Lubricants listed in order of preference. Do not mix types of oil.

Table 1, Approved Allison Transmission Lubricants

Transmission Lubricant Capacities	
Model	**Refill Capacity* quarts (liters)**
1000/2000/2400 Standard Sump	10.6 (10)
1000/2000/2400 Shallow Sump	7.4 (7)

* Quantities listed are approximate. Add the recommended amount of fluid as listed under refill capacity. Do not overfill.

Table 2, Transmission Lubricant Capacities

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Interlube Chassis Lubrication System Inspecting	31–01
Safety Precautions	31–00

31–00 Safety Precautions

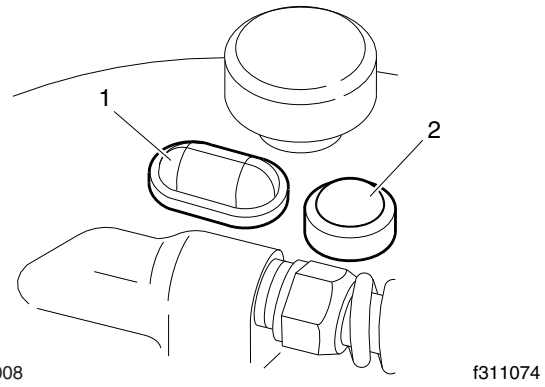
Saftey Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

31–01 Interlube Chassis Lubrication System Inspecting

1. Inspect all lubrication points for signs of fresh grease.
2. Check the condition of all fittings and connections. Tighten or replace loose or damaged fittings.
3. Check all lubrication lines; be sure there are no breaks. Check for wear or chafing that may lead to leakage.
4. Confirm pump operation by pressing the manual override button (located on top of the reservoir) and check to see if the indicator light flashes. See **Fig. 1**.



1. Indicator Light
2. Manual Override Button

Fig. 1, Interlube System Reservoir

5. Using clean grease, fill the reservoir every 2 to 3 months as follows. See **Table 1** for a list of approved grease.

   IMPORTANT: To avoid air pockets and contaminants from entering the reservoir, use the grease fill fitting when filling the reservoir.

   5.1 Remove the dirt cap from the grease fill fitting, then wipe the grease fill fitting to remove any dirt.

Approved Grease*	
NLGI Grade	**Temperature Rating: Down to F° (C°)**
2	10 (–12)
1	0 (–18)
0	–10 (–23)
00	–20 (–29)
000	–30 (–34)

* Do not use heavy/tacky grease, or clay based high-temperature grease.

Table 1, Approved Grease

   5.2 Using approved grease, fill the reservoir through the grease fill fitting to the maximum level label on the reservoir.

   5.3 Install the dirt cap on the grease fill fitting.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Component Inspecting and Operation Checking, Freightliner AirLiner	32–03
Freightliner Suspension Inspecting	32–02
Safety Precautions	32–00
Suspension Inspecting	32–01
Suspension U-Bolt Torque Checking	32–04

32–00 Safety Precautions

Saftey Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

32–01 Suspension Inspecting

Front and Rear Suspension Spring Assemblies

Some reverse bow in the suspension leaf springs is normal. Deflection in the springs is affected by the carrying capacity of the spring package furnished with the chassis and the load applied. If the springs appear to bow considerably more than normal, have a service dealer check for broken springs, or (consider) adding a heavier spring package.

Rear Air Suspension

Follow the procedure below to determine if a pressure drop in the rear air suspension system is within the allowable range.

Air-Consuming Devices Turned Off

NOTE: With all air-consuming devices turned off (service brakes released and parking brake applied [exhausted]), pressure drop must not exceed 2 psi (14 kPa) in one minute.

1. Park the vehicle on a level surface, place the transmission in Neutral (N), and apply the parking brake.
2. Turn off all air-consuming devices.
3. Run the engine until the air system reaches full pressure.

NOTE: The minimum compressor cut-out pressure is 110 psi (758 kPa).

4. Shut down the engine and wait one minute for the air pressure to stabilize. Note the reading on the air pressure gauge.
5. Wait one additional minute and check the gauge reading again to see if there has been any pressure drop.
6. Pressure drop from air leakage must be less than 2 psi (14 kPa).

Air-Consuming Devices in Use

NOTE: With the service brakes applied and the parking brake released (pressurized), pressure drop must not exceed 3 psi (21 kPa) in one minute.

1. Park the vehicle on a level surface, place the transmission in Neutral (N), and chock the tires to prevent the vehicle from rolling.
2. Turn off all air-consuming devices.
3. Run the engine until the air system reaches full pressure.

NOTE: The minimum compressor cut-out pressure is 110 psi (758 kPa).

4. Release the parking brake.
5. Shut down the engine, apply the brake pedal fully, and wait one minute for the air pressure to stabilize. Note the reading on the air pressure gauge.
6. Wait one additional minute (with the brake pedal fully applied) and check the gauge reading again to see if there has been any pressure drop.
7. Pressure drop from air leakage must be less than 3 psi (21 kPa).

32–02 Freightliner Suspension Inspecting

Spring Front and Rear Suspension Spring Assemblies Inspection

Inspect the front and rear suspension spring assemblies for pitted, cracked, broken, or abnormally bent leaves and extreme rust. If any of these conditions exist, replace the spring assembly. See **Group 32** of

the *Walk-In Van Chassis Workshop Manual* for instructions, or take the vehicle to an authorized Freightliner dealer.

⚠ WARNING

Do not replace individual leaves of a damaged leaf spring assembly; replace the complete spring assembly. Visible damage (cracks or breaks) to one leaf causes hidden damage to other leaves. Replacement of only the visibly damaged part(s) is no assurance that the spring is safe. On front spring assemblies, if cracks or breaks exist in the two top leaves, a loss of vehicle control could occur. Failure to replace a damaged spring assembly could cause an accident resulting in property damage, serious personal injury, or death.

IMPORTANT: On multi-leaf suspensions, closely inspect each component of the leaf spring assemblies, including the brackets, U-bolts, and related parts.

Spring Shock Absorber Check

Make sure that the shock absorber brackets are tight and that the shock absorber is not striking or rubbing on the frame or some other part of the chassis. Check the rubber mounting bushings and replace them if worn. Inspect the shock absorber for oil leakage, which is defined as being drips of oil on the sides of the shock absorber.

If the shock absorber is worn or damaged, replace it with a new one.

Single Spring and Radius Rod Bushing Check

1. Without detaching the torque arms, use your hand to attempt to move each of the radius rod ends up, down, in, and out. If there is any movement, replace the torque arm.
2. Inspect the weld seams between the torque arm tube and the shorter bushing tubes. If there are cracks, replace the torque arm. Do not weld the torque arm for any reason.
3. Inspect the rubber bushing ends. See **Fig. 1**. Replace the torque arm for any of the following reasons:
   - There are gaps between the rubber bushing and the pin or the outer steel sleeve.
   - Either bushing end contacts a torque arm pin mounting bolt.
   - There are cracks in the bushing.
   - Part of the rubber bushing extends beyond the outside diameter of the outer bushing sleeve.

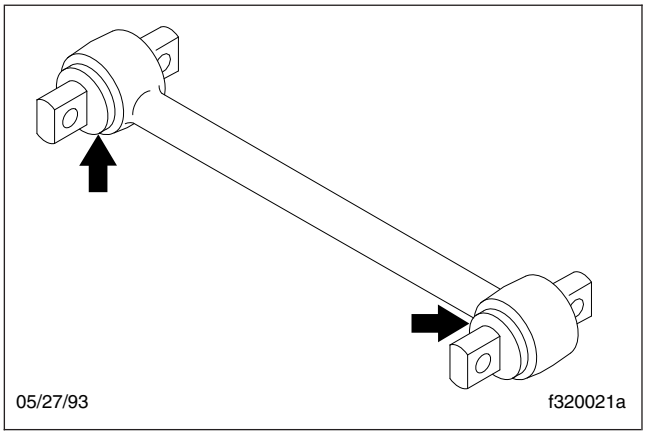


Fig. 1, Torque Arm Bushings

56-Inch Multi-Leaf Spring Component Check

No lubrication is required on the 56-inch multi-leaf spring rear suspension.

Inspect the stabilizer bar, if present, for irregular bushing wear or cracks in the brackets. Check the rubber helper spring, if present, for cracks.

AirLiner Component Clearance Check

Check that the air line support brackets are positioned so the air lines do not rub against anything. Reposition any configurations that could contact the air line and result in friction and wear. There must be at least 1 inch (25 mm) clearance around the rubber air spring when inflated. If the clearance is less than 1 inch (25 mm), relocate the obstructing parts.

NOTICE

Failure to relocate obstructing parts could result in damage to the air spring.

AirLiner Control Rod Check

1. Without disconnecting the control rods, use your hand to attempt to move each of the control rod ends up, down, in, and out. If there is any movement, examine the control rods for wear or damage. Replace the control rod(s) if necessary.
2. Inspect the rubber bushings for cracks or cuts.
3. Check for any shifting of the barpin.
4. Check for cracks in the metal components and welds.

32–03 Component Inspecting and Operation Checking, Freightliner AirLiner

⚠ WARNING

Inspect the components and check their operation as described below. Failure to perform these inspections and checks could result in separation of worn suspension components and loss of vehicle control, possibly causing personal injury and property damage.

1. Chock the front tires. Raise the rear of the vehicle so that the tires just clear the ground and so that the suspension is fully extended. Place safety stands under the vehicle frame.
2. Squeeze all air springs to check for complete deflation. If any air springs remain partially or fully inflated, see **Group 32** of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
3. Inspect each air spring for wear at its connection to the pedestal. Replace any worn air springs; for instructions, see **Group 32** of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
4. Check the axle connection welds (beam-seat to equalizing-beam) and axle-adapter to axle for cracks. If welds are cracked, take the vehicle to an authorized Freightliner dealer for repair.
5. Move the axle up and down while checking for signs of looseness due to worn parts at the front pivot connections. Replace any worn parts by following the procedures in **Group 32** of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
6. Inspect the shock absorbers for oil leaks and worn rubber bushings. Replace the shock absorbers and/or rubber bushings if wear or damage is noted. For instructions, see **Group 32** of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
7. Remove the safety stands and lower the rear of the vehicle to the ground. Run the engine until air pressure of at least 100 psi (689 kPa) is maintained throughout the system.
8. Check that all air springs are inflated. If the air springs do not inflate, see **Group 32** of the *Walk-In Van Chassis Workshop Manual* for possible causes and corrections, or take the vehicle to an authorized Freightliner dealer.

32–04 Suspension U-Bolt Torque Checking

Check the U-bolt torque of both the front and rear axles where applicable.

NOTICE

Failure to retorque the U-bolt nuts could result in spring breakage and abnormal tire wear.

1. Park the vehicle on a flat surface and apply the parking brake. Chock the tires.
2. Check the U-bolt torque in a diagonal pattern. Set a click-type torque wrench to the highest torque value for the fastener being checked. See **Table 1** for U-bolt torque specifications. Turn the wrench in a clockwise motion (looking up) until the torque wrench clicks.
3. Remove the chocks.

U-Bolt Torque Values		
Description	**Size**	**Torque: lbf·ft (N·m)***
Spring Assembly U-Bolt High Nuts	5/8–18	Stage 1: Hand tighten Stage 2: 60 (81) Stage 3: 180 (244) Stage 4: 200 to 230 (271 to 312)
	3/4–16	Stage 1: Hand tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 270 to 330 (367 to 449)
	7/8–14	Stage 1: Hand tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 420 to 500 (571 to 680)
	1–14	Stage 1: Hand tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 520 to 600 (707 to 816)

* Tighten in the sequence shown in **Fig. 2**.

Table 1, U-Bolt Torque Values

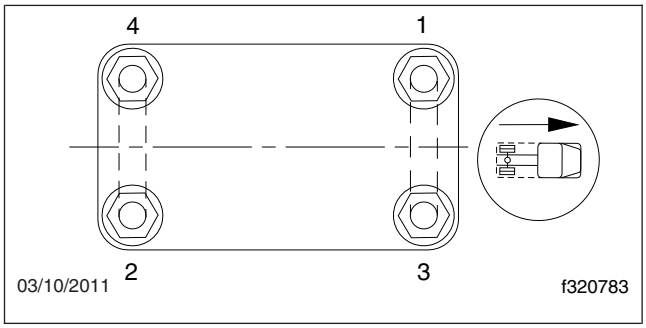


Fig. 2, Tightening Sequence for U-Bolt High Nuts

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
All-Axle Alignment Checking	33–04
Grease-Lubricated Wheel Bearing Cleaning, Inspecting, Repacking and Adjusting, Front Axle	33–01
Knuckle Pin Lubricating	33–02
Oil-Filled Hubs Oil Changing	33–06
Oil-Filled Hubs Oil Level Checking	33–05
Safety Precautions	33–00
Tie-Rod End Lubricating and Inspecting	33–03

33–00 Safety Precautions

Saftey Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

33–01 Grease-Lubricated Wheel Bearing Cleaning, Inspecting, Repacking and Adjusting, Front Axle

See **Group 33** of the *Walk-In Van Chassis Workshop Manual* for grease-lubricated wheel bearing service procedures, or take the vehicle to an authorized Freightliner dealer.

33–02 Knuckle Pin Lubricating

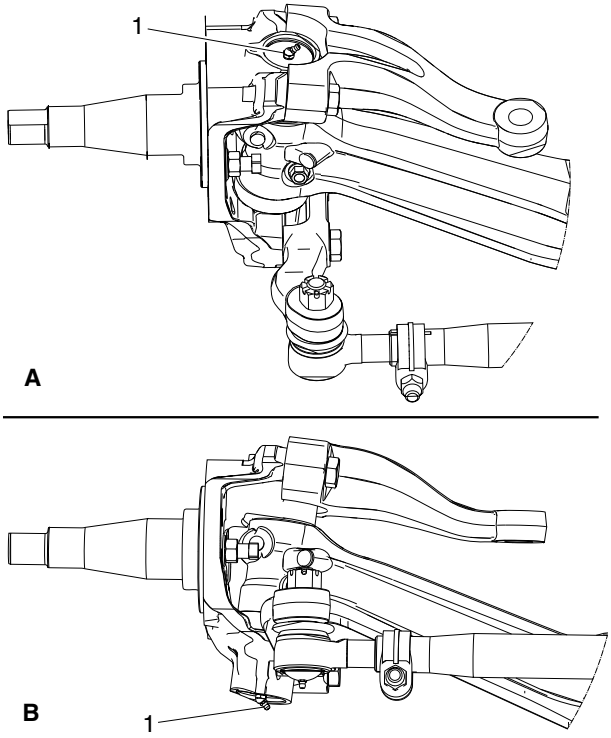
NOTICE

Use regulated pressure when lubricating the knuckle assemblies, otherwise damage could result to the knuckle caps.

Detroit™ Axles

On the front axle, grease fittings are on the top and bottom caps of each knuckle.

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires. When lubricating upper and lower knuckle assemblies, do not raise the front axle.
2. Wipe the grease fittings clean.
3. Apply multipurpose chassis grease, NLGI Grade 1 (6% 12-hydroxy lithium stearate grease) or NLGI Grade 2 (8% 12-hydroxy lithium stearate grease), until new grease is seen at the junctions of the axle beam and knuckles. For locations of grease fittings, see **Fig. 1**; for grease exit points, see **Fig. 2**.



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A Upper View, LH Side B Lower View, LH Side
1. Grease Fitting

Fig. 1, Grease Fittings, Detroit Axles

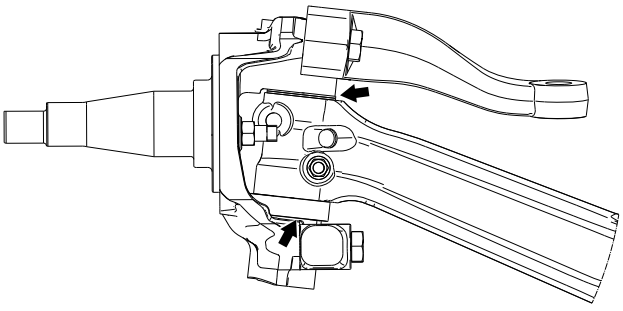

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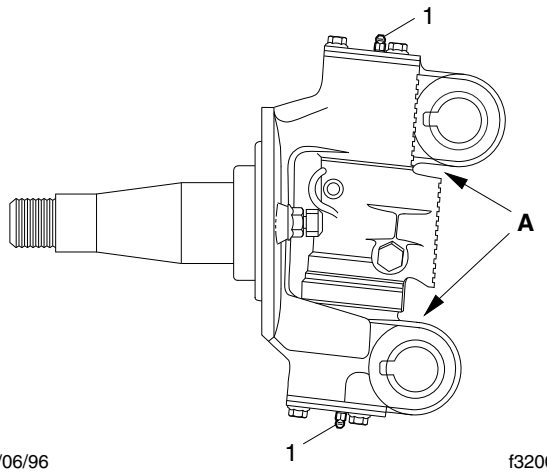
Fig. 2, Knuckle Pin Grease Exit Points, Detroit Axles

Meritor Axles

Hold a pressure gun on each fitting until fresh grease appears. See **Fig. 3**. This will ensure that all of the old contaminated grease has been forced out. It is not necessary to exceed 4000 psi (27 560 kPa). The best distribution of new lubricant and the best purging of old lubricant occurs when about 4000 psi (27 560 kPa) pressure is applied at the grease gun nozzle. Using a 40 to 1 booster, the air should be limited to 100 psi (689 kPa); using a 50 to 1 booster, the air should be limited to 80 psi (551 kPa). Higher or lower pressures are not recommended.



Pump lubricant into each grease fitting until fresh grease comes out at A.

1. Grease Fitting

Fig. 3, Grease Fittings, Meritor Axle

When lubricating Meritor knuckle pin bushings *initially (5000 miles [8000 km])*, raise the front axle until the front tires are off of the ground. Wipe the lube fittings clean, and slowly feed multipurpose chassis grease (NLGI grade 1 or 2) into each bushing area while turning the wheels from extreme right to left and back again (lock-to-lock). This will eliminate small air pockets and improve grease distribution.

Lower the tires to the ground, and regrease both top and bottom bushings until new grease is seen at the seal on the bushing opposite the fittings.

NOTE: The grease seal will accept the grease pressure without damaging the seal, and is designed to have grease pumped out through it during lubrication. Even if grease leaks out around the top or bottom plate, continue pumping until new grease is seen at the seal on the bushing opposite the grease fitting.

When lubricating knuckle pin bushings at *indicated maintenance intervals*, do not raise the front axle. Wipe the lube fittings clean, and apply multipurpose chassis grease until new grease is seen at the grease seal on the bushing opposite the fittings.

33–03 Tie-Rod End Lubricating and Inspecting

NOTICE

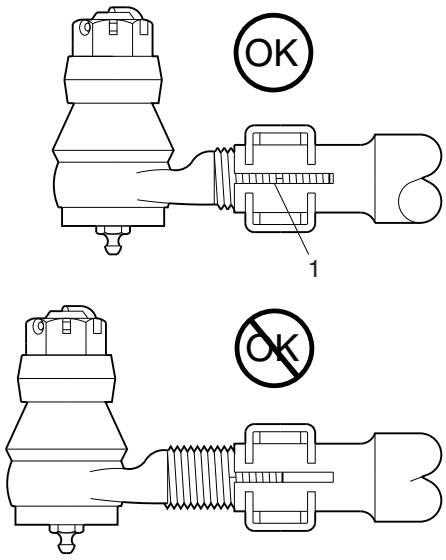
If a power washer is used to clean the chassis in the area of the tie-rod ends, you must adjust the tie-rod end inspection and lubrication intervals. If the vehicle is power washed often, you must inspect and lubricate the tie-rod ends more frequently.

IMPORTANT: DOT roadside tie-rod assembly replacement criteria specifies that if tie-rod end-play is 1/8 inch (3 mm) or greater, measured on the road, the vehicle must be taken out of service immediately. If less than 1/8 inch (3 mm), the vehicle does not have to be taken out of service but a major out-of-service inspection and maintenance must be scheduled as soon as possible.

NOTE: Inspect the tie-rod end boots for cracks, wear, or damage. If a boot is cracked, worn, or damaged, replace the tie-rod assembly.

1. Wipe the tie-rod end grease fittings clean, then (for Detroit or Meritor axles) pump multipurpose chassis grease (NLGI grade 1 or 2) to the tie-rod ends until all used grease is forced out and new grease appears at the ball stud neck.
2. Inspect the tie-rod ends, as follows.
   - 2.1 Shake the cross-tube. Movement or looseness between the tapered shaft of the ball and the cross-tube socket members means that the tie-rod end assembly must be replaced.

2.2 The threaded portion of the tie-rod end assembly must be inserted all the way into the cross-tube split, for adequate clamping. See **Fig. 4**. Replace the parts if this cannot be done. For instructions, see the axle manufacturer's service manual.



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IMPORTANT: The tie-rod end threads must be visible throughout the entire length of the split.

NOTE: Pinch bolt not shown to provide clarity.

1. Cross-Tube Split

Fig. 4, Tie-Rod End Adjustment

2.3 Check the tie-rod end nut and clamp nut torques. For Detroit axles, see **Table 1** for tie-rod end nut torque specifications and **Table 2** for tie-rod end clamp nut torque specifications. For Meritor axles, tighten the tie-rod end nut 100 lbf·ft (136 N·m), and tighten the clamp nut 40 to 55 lbf·ft (54 to 75 N·m).

Detroit Axle Tie-Rod End Nut	
Thread	**Torque: lbf·ft (N·m)**
5/8–16	60 to 115 (81 to 156)
5/8–18	60 to 115 (81 to 156)
3/4–16	90 to 170 (122 to 230)

Detroit Axle Tie-Rod End Nut	
Thread	**Torque: lbf·ft (N·m)**
7/8–14	160 to 300 (217 to 407)

Table 1, Detroit Axle Tie-Rod End Nut

Detroit Axle Tie-Rod End Clamp Nut	
Thread	**Torque: lbf·ft (N·m)**
1/2–13	35 to 45 (47 to 61)
5/8–11	40 to 60 (54 to 81)
5/8–18	50 to 64 (73 to 87)
3/4–10	155 to 175 (210 to 237)

Table 2, Detroit Axle Tie-Rod End Clamp Nut

33–04 All-Axle Alignment Checking

Drive Axle Alignment Checking

Check the axle alignment, parallelism, and thrust angle measurements for the rear drive axle. Use the applicable procedure and specifications in **Group 35** of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

Toe-in Inspection

For vehicle alignment to be accurate, the shop floor must be level in every direction. The turn plates for the front wheels must rotate freely without friction, and the alignment equipment must be calibrated every three months by a qualified technician from the equipment manufacturer. Freightliner dealers must have proof of this calibration history.

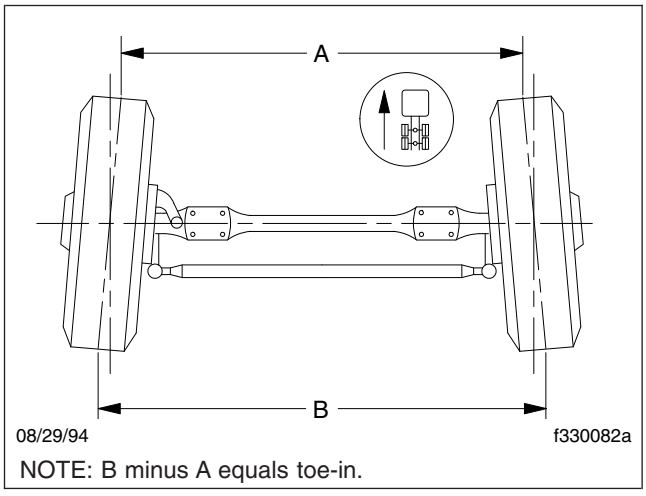
1. Apply the parking brakes, and chock the rear tires.
2. Raise the front of the vehicle until the tires clear the ground. Check that the safety stands will support the combined weight of the body, axle, and frame. Place safety stands under the axle.
3. Using spray paint or a piece of chalk, mark the entire center rib of each front tire.
4. Place a scribe or pointed instrument against the marked center rib of each tire, and turn the tires.

Hold the scribe firmly in place so that a single straight line is scribed all the way around each front tire.

5. Place a turn-plate or turntable under both front tires. Remove the safety stands from underneath the axle, then lower the vehicle. Remove the lock-pins from the gauges; make sure that the tires are pointing straight ahead.

NOTE: If turn-plates or turntables are not available, lower the vehicle. Remove the chocks from the rear tires and release the parking brakes. Move the vehicle backward and then forward about six feet (two meters).

6. Place a trammel bar at the rear of the front tires; locate the trammel pointers at spindle height, and adjust the pointers to line up with the scribe lines on the center ribs of the front tires. See **Fig. 5**. Lock the pointers in place. Check that the scale is set to zero.



NOTE: B minus A equals toe-in.

Fig. 5, Wheel Toe-In (overhead view)

7. Place the trammel bar at the front of the tires and adjust the scale end so that the pointers line up with the scribe lines. See **Fig. 6** and **Fig. 7**.
8. Read the toe-in from the scale, and compare it to the toe-in specification in **Group 33** of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer. If corrections are needed, see **Group 33** of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

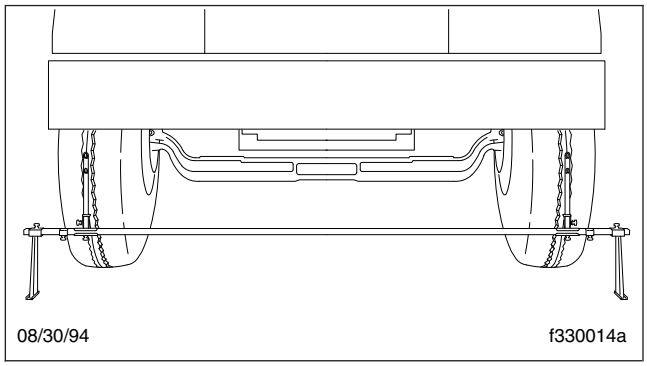


Fig. 6, Trammel Bar Positioning

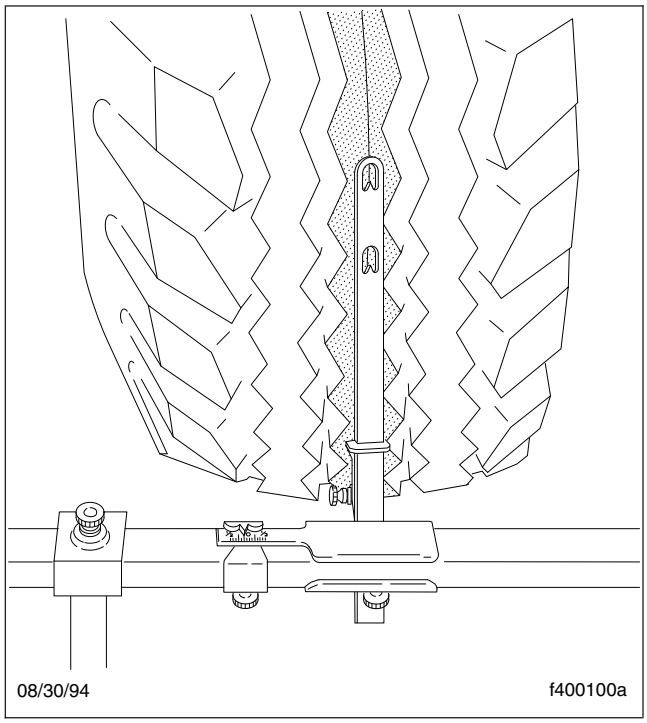


Fig. 7, Setting Trammel Bar Pointers

33–05 Oil-Filled Hubs Oil Level Checking

⚠ WARNING

Be careful not to overfill the hubs. Overfilling may cause oil to be forced out of the hubs and to contaminate the brake linings and other brake components. This could result in loss of vehicle control and lead to personal injury and property damage.

1. With the vehicle on a level surface, rotate the front wheels and allow the oil in the hubs to settle.
2. Chock the tires.

IMPORTANT: The oil level should be at, or no more than 1/4 inch (6 mm) above the level indicators on the hub caps.

3. If necessary, remove the filler caps (in the ends of the hub caps) and add enough oil (80W–90 hypoid gear oil) to bring the oil to the proper level.
4. Rotate the wheels, allow the oil to settle, and check the levels again.
5. Install the filler caps securely.
6. Remove the chocks from the tires.

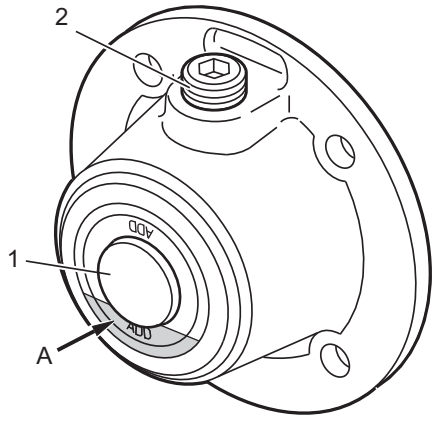
33–06 Oil-Filled Hubs Oil Changing

⚠ WARNING

Be careful not to overfill the hubs. Overfilling may cause oil to be forced out of the hubs and to contaminate the brake linings and other brake components. This could result in loss of vehicle control and lead to personal injury and property damage.

1. With the vehicle on a level surface, rotate the front wheels so that the front hub drain plugs are positioned downward.
2. Chock the tires.
3. Place suitable containers under the hubs, remove the filler caps (in the ends of the hub caps) and the drain plugs, and allow the hubs to drain completely. See **Fig. 8**.
4. Install the drain plugs and tighten 25 lbf·in (282 N·cm).
5. Add approximately 1 to 1-1/2 pints (0.5 to 0.7 L) of oil (80W–90 hypoid gear oil) to each hub.
6. Rotate the wheels, allow the oil to settle, and check the levels.

IMPORTANT: Fill the hubs to the level indicators on the hub caps, or to no more than 1/4 inch (6 mm) above the indicators. See **Fig. 8**.



A. Hub Cavity Full
1. Fill Plug/Magnetic Drain
2. Drain Plug

Fig. 8, Oil-Filled Hub Cap

7. Install the filler caps securely.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Axle Breather Checking	35–03
Axle Lubricant Changing	35–01
Axle Lubricant Checking	35–02
Safety Precautions	35–00

35–00 Safety Precautions

Saftey Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

35–01 Axle Lubricant Changing

Procedures for Detroit™ and Meritor axles are provided below.

Detroit Axle

Axle Draining

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Clean the fill plug and the area around it. Remove the plug from the oil fill hole. See **Fig. 1**.

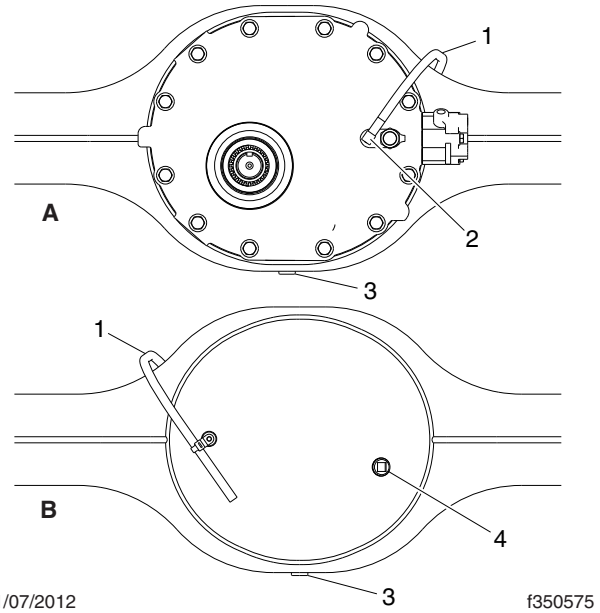
⚠ CAUTION

Be careful when draining the axle oil. It may be very hot, and could cause personal injury if it contacts the skin.

3. Remove the plug at the bottom of the housing and drain the lubricant while the unit is warm. Allow enough time for all the old lubricant to drain completely.
4. Clean the drain plug. For magnetic drain plugs, a piece of key stock or any other convenient steel slug may be used to short the two magnetic poles and divert the magnetic field.
5. After cleaning the drain plug, install and tighten the plug 30 lbf·ft (41 N·m).

Axle Filling

1. With the vehicle on a level surface, fill the axle housings to the bottom of the oil fill hole (in the carrier or housing) with recommended lubricant; see **Table 1**. Refer to **Table 2** for Detroit drive axle lubricant capacities.
2. Install the fill hole plug and tighten it 30 lbf·ft (41 N·m).
3. After filling the carrier and housing assembly with lubricant, drive the vehicle unloaded for one or two miles (two or three kilometers) at speeds not to exceed 25 mph (40 km/h) to thoroughly circulate the lubricant throughout the assembly.



A. Front View
B. Rear View
1. Breather Hose
2. Axle Housing Breather
3. Oil Drain Plug
4. Oil Fill Plug

Fig. 1, Component Locations, Detroit Axle

Detroit Drive Axle Lubricants*		
IMPORTANT: Lubricant used in Detroit rear axles must meet Mercedes-Benz specification 235.20 (mineral) or 235.8 (synthetic). Mobil Delvac™ Gear Oil A 80W-90 and Mobilube™ HD-A Plus 80W-90 meet specification 235.20. Mobil Delvac 1 Gear Oil 75W-90 and Mobilube 1 SHC 75W-90 meet specification 235.8. For more product information, see http://bevo.mercedes-benz.com.		
Type	**Ambient Temperature**	**SAE Viscosity Grade**
Mineral Oil	–15°F (–26.1°C) and up†	80W–90
Synthetic Oil	–40°F (–40°C) and up†	75W–90

* Detroit rear axles do not require the use of friction modifiers.

† There is no upper limit on the ambient temperature, but axle sump temperature must never exceed 250°F (121°C).

Table 1, Detroit Drive Axle Lubricants

Detroit Drive Axle Lubricant Capacities	
Axle Model*	**Capacity†: pints (L)**
ARS–13.0–2	15 (7)
ARS–15.0–2	15 (7)
ARS–17.5–2	15 (7)
ARS–19.0–2	15 (7)
ARS–20.0–2	15 (7)
ARS–21.0–2	15 (7)
ARS–21.0–4	23 (11)
ARS–23.0–4	23 (11)

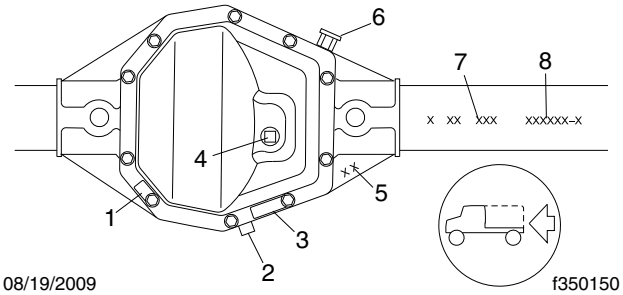
* Model code may have a "D" in the prefix (for example, DA–RS–13.0–2).

† Quantities listed are approximate and include 1 pint (0.5 liter) for each wheel end and with the drive pinion at 3 degrees.

Table 2, Detroit Drive Axle Lubricant Capacities

Meritor Axle

1. Remove the filler plug, then the drain plug and allow the differential to drain completely. See **Fig. 2**.
2. Install and tighten the drain plug securely.
3. Fill the differential with an SAE 80W–90 multipurpose gear lubricant, or an SAE 75W–90 multipurpose synthetic gear lubricant. See **Table 3** for axle lubricant capacities. Either type of lubricant must meet MIL L–2105–D and be suitable for American Petroleum Institute service classification GL–5. The lubricant level within the differential must be even with the bottom of the fill hole.
4. Install and tighten the fill plug securely.



1. Ratio Tag
2. Drain Plug
3. Limited Slip Lubrication Tag
4. Filler Plug
5. Model Number
6. Axle Housing Breather
7. Manufacturing Date
8. Part Number

Fig. 2, Rear Axle Differential, Meritor Axle

Meritor Drive Axle Lubricant Capacities (single axle)*	
Axle Model	**Capacity†: pints (L)**
RS-15-120	16 (7.6)
RS-17-145	33.6 (15.9)
RS-19-145	34.4 (16.3)
RS-21-145	32 (15.1)
RS-23-160	42 (19.9)
RC-23-165	42 (19.9)

* Single drive axles equipped with traction equalizers may require a "friction modifier" to correct a slip-stick condition, as described in the vehicle driver's manual. Meritor's experience shows that the following additives perform adequately: Add Elco No. 2 Friction Modifier (1 ounce [30 ml] of additive for each 1 pint [0.5 liter] of lube capacity) or Lubrizol No. 797 or 762 (one ounce [30 mL] of additive for each 1 pint [0.5 liter] of lube capacity).

† Quantities listed are approximate and include 1 pint (0.5 liter) for each wheel end and with the drive pinion at 3 degrees.

Table 3, Meritor Drive Axle Lubricant Capacities (single axle)

35–02 Axle Lubricant Checking

NOTICE

Failure to keep the rear axle filled to the proper level with the recommended lubricant can result in rear axle damage.

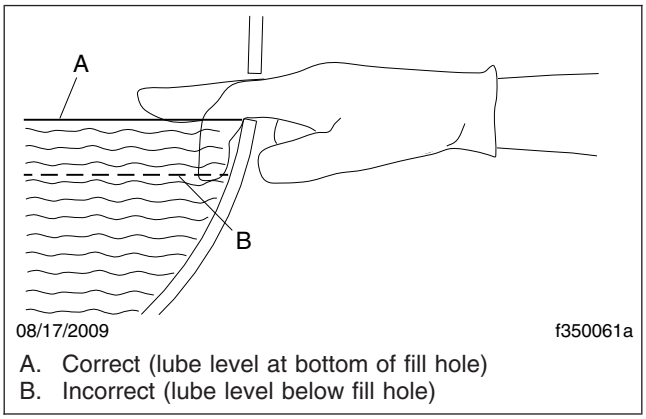
NOTE: If the vehicle is exposed to water deep enough to cover the hubs, disassemble and inspect them for water damage and/or contamination. See **Group 35** of the *Walk-In Van Chassis Workshop Manual* for instructions, or take the vehicle to an authorized Freightliner dealer.

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. If the vehicle has just been driven, allow a few minutes for the lubricant to settle.
3. Clean the fill plug and the area surrounding the fill plug on the side of the axle carrier. Remove the plug. Check lubricant level when the axle is cold, or near room temperature. See **Fig. 1** for a Detroit axle, or **Fig. 2** for a Meritor axle.
4. Check that the lubricant is level with the bottom of the fill hole. See **Fig. 3**. If low, check for oil leaks, and correct as needed. Add oil to the level of the fill plug. For a Detroit axle, use the lubricant recommended in **Table 1**.

   For a Meritor axle, add SAE 80W-90 multipurpose gear lubricant, or an SAE 75W-90 multipurpose synthetic gear lubricant. Either type of lubricant must meet MIL L-2105-D and be suitable for American Petroleum Institute service classification GL-5.

IMPORTANT: A lubricant level close enough to be seen or touched is not sufficient. It must be level with the bottom of the fill hole.

5. Install the oil fill plug and tighten it 30 lbf·ft (41 N·m) for Detroit axles or 35 lbf·ft (47 N·m) for Meritor axles.
6. Inspect the axle for signs of leakage. If leakage is indicated and the lubricant level is down, have your dealer perform any necessary maintenance.



A. Correct (lube level at bottom of fill hole)
B. Incorrect (lube level below fill hole)

Fig. 3, Axle Lubricant Level Inspection

Check more often under poor operating conditions. If the breather is plugged, clean or replace it as needed.

35–03 Axle Breather Checking

NOTE: For component locations, see **Fig. 1** for a Detroit axle or **Fig. 2** for a Meritor axle.

The axle housing breather must remain unobstructed. Whenever the axle lubricant level is checked, also check that the axle breather is open.

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Title of Maintenance Operation (MOP)	MOP Number
Wheel Nut Checking	40–01

40–01 Wheel Nut Checking

IMPORTANT: In addition to the maintenance interval in this manual, check the wheel nut torque the first 50 to 100 miles (80 to 160 km) of operation after a wheel has been removed and installed.

NOTE: For all stud-piloted wheels, on each wheel stud, the end that faces away from the vehicle is stamped with an "L" or "R," depending on which side of the vehicle the stud is installed. Studs stamped with an "L" are left-hand threaded and are installed on the driver's side of the vehicle. Studs stamped with an "R" are right-hand threaded and are installed on the passenger's side of the vehicle.

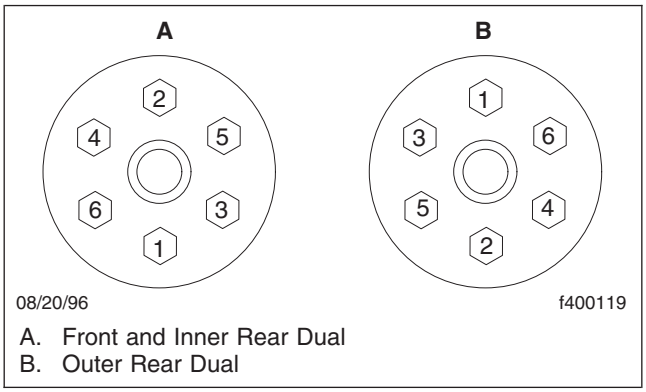
For all stud-piloted wheels, when checking wheel nuts on a dual disc assembly, remove one outer nut at a time, tighten the inner nut, then reinstall the outer nut. Repeat this procedure for all of the inner wheel nuts in the sequence shown in **Fig. 1**, then tighten all of the outer wheel nuts in the same sequence.

⚠ CAUTION

Too little wheel nut torque can cause wheel shimmy, resulting in wheel damage, stud breakage, and extreme tire tread wear. Too much wheel nut torque can break studs, damage threads, and crack discs in the stud hole area.

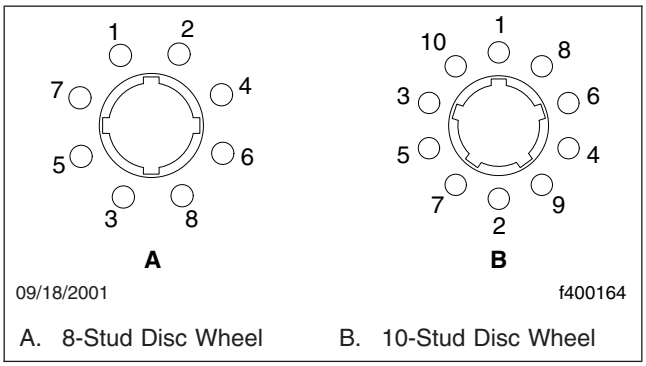
Tighten the wheel nuts 450 to 500 lbf·ft (610 to 680 N·m), and see **Fig. 1** for the tightening sequence of stud-piloted, 6-stud wheels.

For hub piloted, 8- and 10- stud wheels, torque values vary with the stud size; consult the wheel manufacturer for recommended torque values. See **Fig. 2** for the tightening sequence of hub-piloted, 8- and 10-stud wheels. Before tightening, apply 2 drops of SAE 30W oil to a point between the nuts and flanges.



A. Front and Inner Rear Dual
B. Outer Rear Dual

Fig. 1, Wheel Nut Tightening Sequence (stud-piloted 6-stud wheels)



A. 8-Stud Disc Wheel B. 10-Stud Disc Wheel

Fig. 2, Wheel Nut Tightening Sequence (8- and 10-stud hub-mounted wheels)

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Driveline Inspection and Lubrication	41–01
Safety Precautions	41–00

41–00 Safety Precautions

Saftey Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

41–01 Driveline Inspection and Lubrication

Inspection

Before lubricating the driveline U-joints and slip-joints, make the following checks.

1. Check that the yoke-strap capscrews are tightened 50 to 60 lbf·ft (68 to 81 N·m).

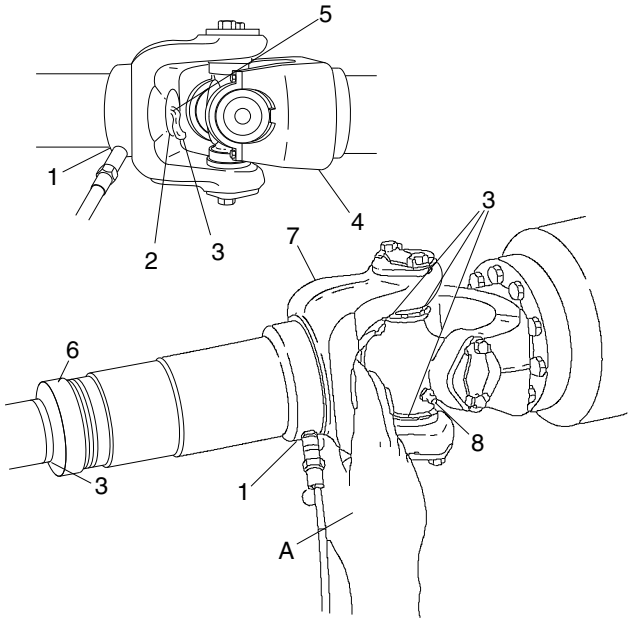
NOTICE

Do not overtighten the yoke-strap capscrews, due to the extreme load occurring at high-speed rotation. A loose or broken capscrew at any point in the driveline weakens the driveline connection, which could eventually result in serious vehicle damage.

2. Check the slip-joints for spline wear by trying to bend the sleeve-yoke and splined shaft back and forth. If looseness is greater than 0.007 inch (0.18 mm), replace both the sleeve-yoke and the splined shaft.
3. Check the driveshaft for missing balance weights, and for debris buildup. Remove any buildup. If any balance weights are missing, remove the driveshaft and have it balanced. For instructions, see **Group 41** of the vehicle *Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
4. Check that the yoke plug is not loose or missing. Replace the yoke plug if needed. If the yoke plug is missing, the splined shaft may be hitting the yoke plug and knocking it out; check the driveshaft for proper length.

U-Joint Lubrication

1. Wipe all old grease and dirt from each U-joint grease fitting.
2. Use a hand-type grease gun, or a high-pressure gun with a low-pressure adaptor, to lubricate the U-joints. See **Fig. 1**.



A. After grease appears, cover the pressure-relief hole while continuing to lubricate.

1. Slip-Joint Grease Fitting (with grease gun attached)
2. Yoke Plug
3. Grease
4. Half-Round Yoke
5. Yoke Plug Pressure-Relief-Hole
6. Slip-Joint Seal
7. Full-Round Yoke
8. U-Joint Grease Fitting

Fig. 1, Slip-Joint and U-Joint Lubricating

NOTE: If a low-pressure adaptor is not used with the high-pressure gun, the U-joints may not receive enough lubricant.

3. Using lithium 12-hydroxy stearate grease (NLGI grade 1 or 2, with EP additives), lubricate until new grease can be seen at all four U-joint seals.

NOTICE

Fresh lubricant must be seen escaping from *all four* of the bearing cup seals of each U-joint. If not, the U-joint may fail prematurely.

4. If the bearing will not take grease, replace the U-joint assembly. For instructions, see **Group 41** of the vehicle *Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
5. Check the old grease. If it appears rusty, gritty, or burned, replace the U-joint assembly. For instructions, see **Group 41** of the vehicle *Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
6. Wipe any excess grease from the seals and grease fittings.

Slip-Joint Spline Lubrication

1. Wipe all old grease and dirt from the slip-joint grease fitting.
2. Use a hand-type grease gun or a high-pressure gun with a low-pressure adaptor, to lubricate the slip-joint. Using lithium 12-hydroxy stearate grease (NLGI grade 1 or 2, with EP additives), lubricate until fresh grease appears at the pressure-relief hole in the yoke plug. Then cover the relief hole with your finger, as shown in **Fig. 1**, while continuing to lubricate until fresh grease appears at the slip-joint seal. This ensures complete lubrication of the splines.
3. Wipe any excess grease from the pressure-relief hole, slip-joint seal, and grease fitting.

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Title of Maintenance Operation (MOP)	MOP Number
Air Dryer Check	42–08
Air Dryer Desiccant and Coalescent Filter Replacement	42–07
Bendix Hydro-Max® Brake System Inspection	42–01
Brake Caliper Slide Pin Lubrication, Bosch Brakes	42–04
Brake Inspection	42–05
Brake Lines Check, Hydraulic Disc Brakes	42–02
Brake Lining Wear Check, Hydraulic Disc Brakes	42–03
Safety Precautions	42–00
Slack Adjuster Lubrication	42–06
Versajust Slack Adjuster Inspection and Lubrication	42–09

42–00 Safety Precautions

Saftey Precautions in this section apply to all procedures within this group.

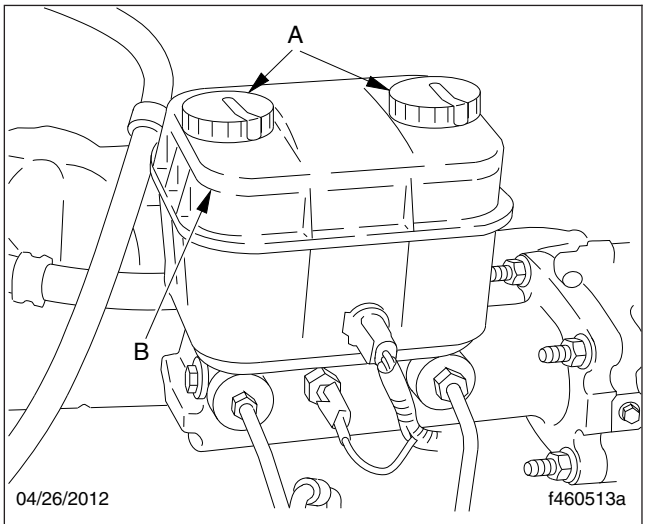
⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

42–01 Bendix Hydro-Max® Brake System Inspection

NOTE: If possible, remove both caps when filling the reservoir. If only one cap can be removed, allow ample time for the reservoir to fill.

1. Check the fluid level in the hydraulic brake fluid reservoir. If needed, fill the reservoir up to the ridge that surrounds the reservoir. See **Fig. 1**. Use only heavy-duty brake fluid, DOT 3.



A. Open caps and check fluid level.
B. Fill to this level.

Fig. 1, Hydraulic Brake Fluid Reservoir

2. Check all hydraulic lines and fittings for damage, leakage, or looseness. Replace damaged or leaking components, and tighten loose fittings.
3. Check the brake module for leaks. If leaks are found, repair or replace the brake module. See **Group 42** of the *Walk-In Van Chassis Workshop Manual* for replacement instructions, or take the vehicle to an authorized Freightliner dealer.
4. Check the electrical connections and harnesses. Make sure the connectors are fully seated and the harnesses are not chafed or cut. Repair or replace any damaged harness. Disconnect any loose connectors and inspect the terminals for corrosion. If corrosion is present, replace the terminals. If corrosion is not present, reconnect the connector.
5. Check the operation of the Hydro-Max brake booster, as follows.
   - 5.1 With the ignition off, depress the brake pedal; listen for the back-up motor to engage. The operator should feel the pedal force relieve and the pedal should depress easily.
   - 5.2 With the ignition on, engine running, and park brake released; operator checks that the BRAKE warning indicator is not on. This is a dual indicator, and it indicates that the park brake is set, and it warns if there is a hydro-max failure condition other than loss of back-up motor power.
6. Check the fuse for the hydraulic brake booster pump, as follows.
   - 6.1 Open the cover to the main power distribution module (PDM).
   - 6.2 Pull the fuse in position F6 for the Hydro-Max relay.
   - 6.3 Inspect the relay to make sure the fuse is not damaged. If the fuse is damaged, install a new fuse. If the fuse is not damaged, install the fuse in position F6.
   - 6.4 Close the PDM cover.

42–02 Brake Lines Check, Hydraulic Disc Brakes

Check all hydraulic lines and fittings for damage, leakage, or looseness.

Replace damaged or leaking components, and tighten loose fittings.

42–03 Brake Lining Wear Check, Hydraulic Disc Brakes

Before checking lining wear with the wheel removed, review the following brake lining exposure warnings.

⚠ WARNING

Breathing brake lining dust (asbestos or non-asbestos) could cause lung cancer or lung disease. Unless exposure can be reduced below legal limits, wear an air purifying respirator approved by MSHA or NIOSH at all times when servicing the brakes, starting with removal of the wheels and continuing through assembly.

To minimize the possibility of creating airborne brake lining dust, clean the dust from the brake rotor, brake caliper, and brake assembly, using an industrial-type vacuum cleaner equipped with a high-efficiency filter system. Then, using a rag soaked in water and wrung until nearly dry, remove any remaining dust. Do not use compressed air or dry brushing to clean the brake assembly.

1. Check lining wear.
   - 1.1 Apply the parking brake and chock the tires to prevent vehicle movement.
   - 1.2 On front and rear axles, replace linings worn to less than 3/16 inch (4.8 mm).
   - 1.3 Make sure that the brake rotor and linings are free of oil and grease.
2. If the wheel and hub assembly is removed from the axle, check lining wear. Replace the linings on all brake assemblies if worn to less than 3/16 inch (4.8 mm) at the thinnest point.

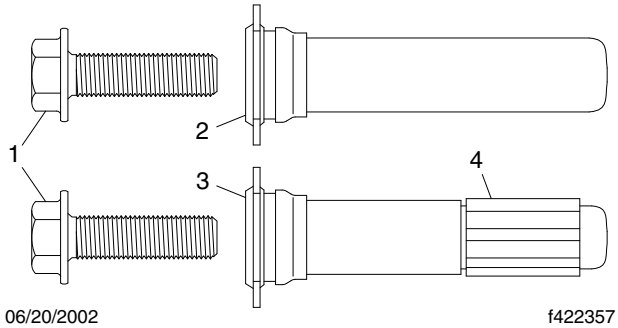
NOTE: To replace the brake linings, see the applicable foundation brake section in **Group 42** of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

42–04 Brake Caliper Slide Pin Lubrication, Bosch Brakes

NOTE: There is no set maintenance interval for lubricating pin-slide hydraulic disc brake calipers.

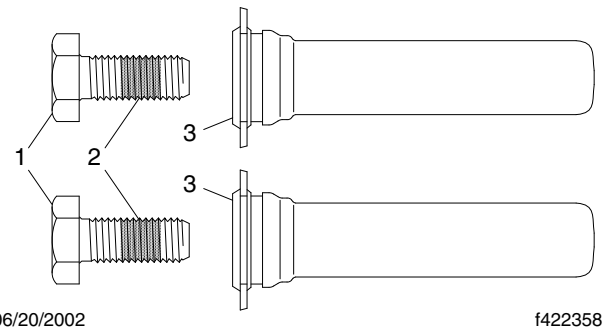
Apply 1/8 oz (3.5 g) Aeroshell grade 5 grease to each of the two guide pin and guide pin bore sets. See the *Bosch Pin Slide Disc Brakes Service Manual* for additional information.

IMPORTANT: The later ZOH-T caliper has important differences from the early ZOPS caliper. ZOPS calipers (since 1998) and ZOH-T calipers (since 2002) use different slide pins and bolts. See **Fig. 4** and **Fig. 3**. The later trailing pin is identified by notches and has a rubber bushing. Flange-head instead of hex-head bolts are used with the later caliper. The later bolts have a fine thread rather than a coarse thread pitch, are longer, differently colored, and are tightened to a higher torque specification. Use only the ZOH-T bolts to assemble a ZOH-T caliper. The ZOPS caliper bolts have a different thread pitch and will not assemble correctly in a ZOH-T caliper mounting. Also, the ZOH-T bolts will not assemble correctly in a ZOPS caliper. **Do not interchange parts**. It is permissible to use both ZOH-T pins and ZOH-T bolts in a ZOPS anchor plate, but they must be replaced as sets. Both the pins and the bolts must be changed.



1. Flange-Head Bolt
2. Leading Pin
3. Trailing Pin
4. Rubber Bushing

Fig. 2, ZOH-T Slide Pins and Bolts



1. Hexhead Bolt
2. Blue Patch
3. Slide Pin

Fig. 3, ZOPS Slide Pins and Bolts

⚠ DANGER

The correct pins, bolts, and bolt torque must be used. If not, brake function could be impaired and lead to loss of control of the vehicle, which could result in personal injury, death, or property damage.

IMPORTANT: The ZOH-T caliper assembly is similar in appearance to the existing ZOPS caliper. The only obvious difference is that one of the anchor plate slide pins (trailing side) has notches for identification. With ZOH-T calipers, install the solid pin (no bushing) only in the anchor plate leading hole position. Install the pin with the rubber bushing and notches only in the anchor plate trailing hole position. Tighten the leading-side pin first, then tighten the trailing-side pin.

Tighten ZOH-T bolts 93 to 107 lbf·ft (126 to 145 N·m). Tighten ZOPS bolts 70 to 80 lbf·ft (95 to 108 N·m).

42–05 Brake Inspection

IMPORTANT: This procedure should be performed prior to lubrication of the brake components.

If the brakes must be repaired, or they require adjustment, see **Group 42** of the *Walk-In Van Chassis Workshop Manual* for repair, adjustment, and troubleshooting procedures. Or take the vehicle to an authorized Freightliner dealer.

Pneumatic (Air) Parking Brake Operational Check

⚠ CAUTION

Perform the following check in a clear safe area. If the parking brakes fail to hold the vehicle, personal injury or property damage may result.

1. With the engine running, and air pressure at cut-out pressure, set the parking brake.
2. Put the vehicle in the lowest gear and gently attempt to move it forward. The vehicle should not move. If the vehicle moves, the parking brakes are not operating correctly and must be repaired before the vehicle is returned to service.

Air Brake Component Inspection

1. Park the vehicle on a level surface, set the parking brake, and chock the tires. Once the tires are chocked, release the parking brake.

⚠ WARNING

Manually adjusting an automatic slack adjuster to bring the pushrod stroke within legal limits is likely masking a mechanical problem. Adjustment is not repairing. Before adjusting an automatic slack adjuster, troubleshoot the foundation brake system and inspect it for worn or damaged components. Improperly maintaining the vehicle braking system may lead to brake failure, resulting in property damage, personal injury, or death.

2. With the engine off, and 100 psi (689 kPa) of air tank pressure, have an assistant apply and hold an 80 to 90 psi (550 to 620 kPa) brake application.
3. Check to see if the colored over-stroke band on each brake chamber pushrod is exposed.

   If a band shows, the stroke is too long. Check the foundation brake components for wear or damage, and repair as needed.
4. Measure the applied chamber stroke. See **Table 1** for the proper stroke for the type of chamber being used. If the stroke is too short,

the brakes may drag or will not fully apply. Check for improper operation or adjustment of the automatic slack adjuster.

5. Start the engine and build air pressure to at least 100 psi (689 kPa). Shut down the engine.
6. Check all of the foundation brake components for damage, wear, and loose or missing parts. Repair as needed.

Mechanical Parking Brake Component Inspection

1. Park the vehicle on a level surface, set the parking brake, and chock the tires. Once the tires are chocked, release the parking brake.
2. If more than 3/4 of the available travel of the parking brake is required to hold the vehicle, the parking brake lining should be checked and, if needed, repaired by an authorized Freightliner dealer.
3. Inspect the parking brake shoes for lining wear. If thickness of any lining material is worn to within 0.030 inch (0.79 mm) of the shoe table at the thinnest place, replace both of the shoe and lining assemblies.

42–06 Slack Adjuster Lubrication

IMPORTANT: Perform **Maintenance Operation 42–07** before lubricating the slack adjusters.

Automatic slack adjusters must be lubricated periodically to ensure proper brake operation.

⚠ WARNING

Failure to lubricate slack adjusters could lead to dragging brakes or a brake failure, resulting in property damage, personal injury, or death.

Meritor

Lubricate the slack adjuster at the grease fitting until grease is forced past the pressure-relief capscrew or past the gear splines around the inboard snap ring. Use high-temperature, NLGI Grade 1 waterproof grease. See **Fig. 4**.

Brake Chamber Stroke Specifications			
Chamber			Max Applied Stroke: inch (mm)
Manufacturer	Type*	Size†	
Meritor	Standard Stroke	9	Less than 1-1/2 (38)
		12	
		16	Less than 1-3/4 (44)
		20	
		24	Less than 1-7/8 (48)
	Long Stroke	24	Less than 2 (51)
	Standard Stroke	30	

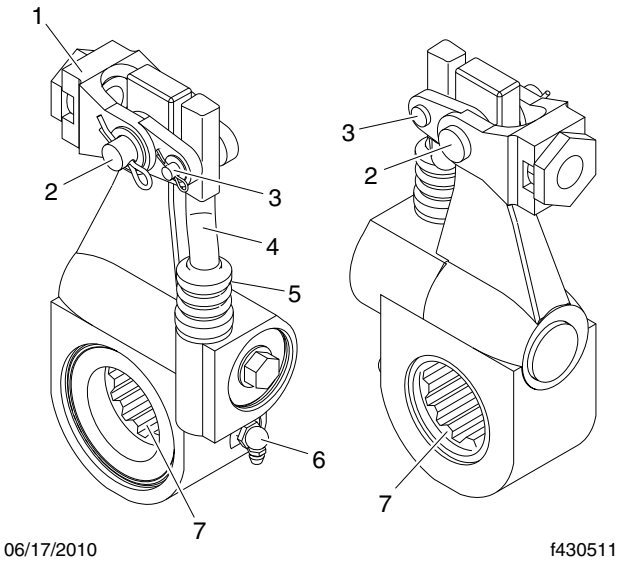
* Long stroke design is indicated by a tag, or embossing, on the brake chamber.

† Specifications are relative to a brake application with 80 to 90 psi (550 to 620 kPa) air pressure in the brake chambers.

Table 1, Brake Chamber Stroke Specifications

Bendix

Using a quality multipurpose chassis lubricant, NLGI Grade 2, lubricate the automatic slack adjuster through the lube fitting. See **Fig. 5**. Lubricate the slack adjuster until clean lubricant flows from the grease relief opening in the boot.



1. Yoke
2. Yoke Pin
3. Link Pin
4. Link
5. Boot
6. Lube Fitting
7. Worm Gear

Fig. 5, Bendix Automatic Slack Adjuster

42–07 Air Dryer Desiccant and Coalescent Filter Replacement

Bendix AD-9

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Completely drain all air reservoirs. Air pressure gauges should read 0 psi (0 kPa).
3. Loosen the desiccant cartridge with a strap wrench at the base of the cartridge. Spin off the cartridge and discard it.
4. Remove the O-ring from the threaded neck and discard it.
5. Remove the coalescent filter and discard it.

IMPORTANT: Lubricate the new O-rings prior to installation.

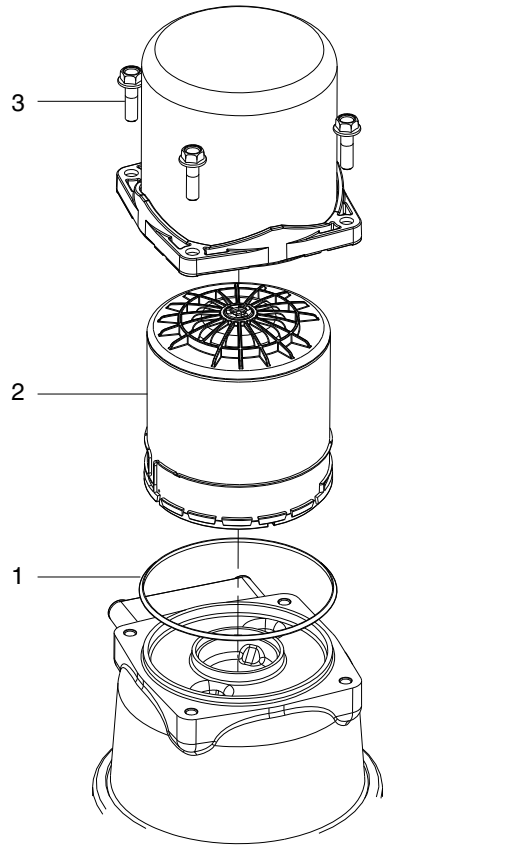
6. Install the new small O-ring in the groove on the bottom of the new coalescent filter.
7. Insert the coalescent filter with the O-ring end going into the air dryer opening first. The end of the filter with the "X" will then be facing out.
8. Install the other new O-ring over the threaded neck of the desiccant cartridge.
9. Screw on the desiccant cartridge until resistance is detected. Then, tighten the cartridge 1/4 to 3/4 of a turn by hand.
10. Before placing the vehicle in service, perform the test below.
    - 10.1 Start the engine and build air pressure to 120 psi (827 kPa).
    - 10.2 Listen for the purge valve to open and release air. A large volume of air will be expelled, followed by a slow flow of air lasting approximately 30 seconds.
    - 10.3 Shut down the engine.
    - 10.4 Perform the checks in **Maintenance Operation 42–10**.

Haldex PURest[1]

NOTE: The PURest cartridge contains both the desiccant and filter in one piece.

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Remove the four mounting bolts and discard. See **Fig. 6**. Lift the canister about ½ inch and remove.
3. Place the assembly upside-down as shown in **Fig. 7**. Press the cartridge down to compress the rubber spring then rotate counterclockwise 45 degrees to release the cartridge. The cartridge itself contains no hazardous material, but there may be a small amount of oil from the compressor.
4. Clean the inside of the canister and aluminum housing.
5. Remove the cartridge O-ring and discard.
6. Remove the new cartridge from the kit and make certain the rubber spring is attached. See **Fig. 8**.

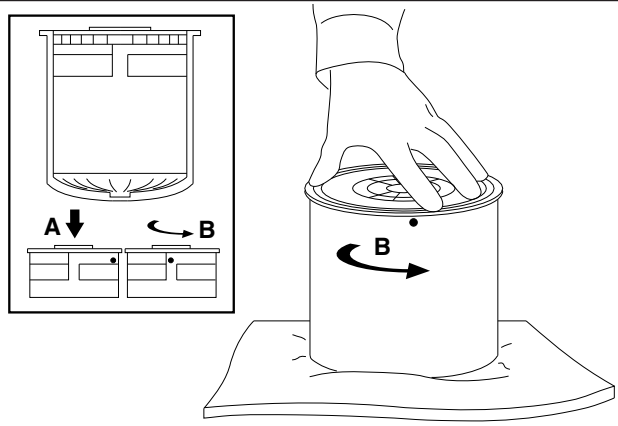
[1]Information in this section is provided by Haldex and is used with permission.



1. O-ring
2. Cartridge
3. Mounting Bolts

Fig. 6, PURest Air Dryer Assembly

7. Install the new cartridge into the canister. Align the slots on the cartridge with the dimplets inside the canister. Press the cartridge into the canister and rotate clockwise 45 degrees to engage the cartridge, as shown in **Fig. 9**.
8. Place a new O-ring on the aluminum housing.
9. Place the cartridge assembly on the air dryer housing and install four new mounting bolts. Use an alternating diagonal pattern and tighten the bolts 35 to 40 lbf·ft (47 to 54 N·m).
10. Before placing the vehicle in service, perform the test below.
    - 10.1 Start the engine and build air pressure to 100 psi (690 kPa) and shut-off the engine.



A. Canister/cartridge assembly shown upside-down.
B. Rotate the cartridge counterclockwise 45 degrees to release it from the canister.

Fig. 7, Releasing the Cartridge

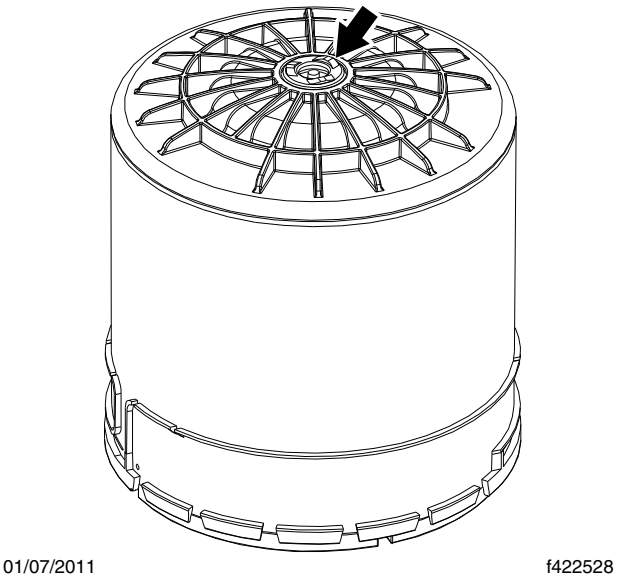
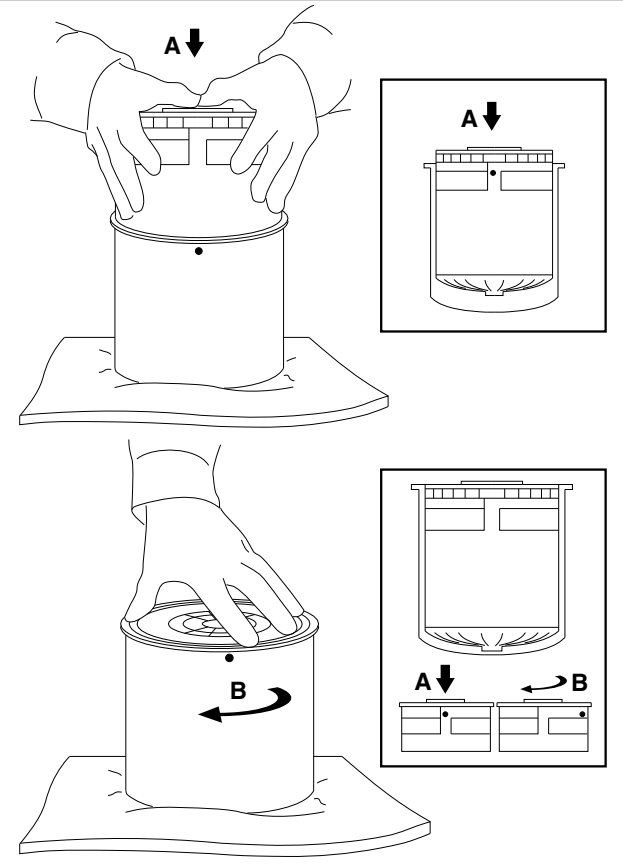


Fig. 8, New Cartridge with Rubber Spring

- 10.2 Check for air leaks at the inlet, outlet, and canister assembly. Correct any leakage problem.
- 10.3 Restart the engine and build-up pressure to cut-out pressure. At cut-out pressure, the air dryer purge valve opens and immediately expels a large volume of air,



A. Install the new cartridge into the canister.
B. Press the cartridge into the canister and rotate clockwise 45 degrees to engage the cartridge.

Fig. 9, Cartridge Rotation and Engagement

followed by a slow flow of air lasting approximately 30 seconds.

10.4 Perform the checks in **Maintenance Operation 42–10**.

42–08 Air Dryer Check

IMPORTANT: Review the warranty policy before performing any intrusive maintenance procedures. An extended warranty may be voided if intrusive maintenance is performed during this period.

Because no two vehicles operate under identical conditions, maintenance and maintenance intervals will vary. Experience is a valuable guide in determining the best maintenance interval for any one particular operation.

Every six months:

1. Check for moisture in the air brake system by opening reservoir drain valves and checking for presence of water. If moisture is present, the desiccant cartridge may require replacement; however, the following conditions can also cause water accumulation and should be considered before replacing the desiccant:
   - An outside air source has been used to charge the system. This air did not pass through the drying bed.
   - Air usage is exceptionally high and not normal. This may be due to high air system leakage.
   - In areas where more than a 30-degree range of temperature occurs in one day, small amounts of water can temporarily accumulate in the air brake system due to condensation. Under these conditions, the presence of small amounts of moisture is normal.

NOTE: A small amount of oil in the system is normal and should not be considered as a reason to replace the desiccant cartridge. Some oil at the dryer exhaust is normal.

2. Visually check for physical damage, such as chaffed or broken air and electrical lines and broken or missing parts.
3. Check the mounting bolts for tightness. See **Table 2** for torque values.

Torque Values		
Vendor	**Size**	**Torque: lbf·ft (N·m)**
Bendix	Grade 5, 3/8–16	28 (38)
	Grade 5, 5/8–11	135 (183)
Haldex	1/2–13	45 to 55 (61 to 75)

Table 2, Torque Values

4. Perform the operational and leakage tests listed below.

Operational and Leakage Tests

1. Check all lines and fittings leading to and from the air dryer for leakage and integrity. Repair any leaks found.
2. Build system pressure to governor cutout and note that the dryer purges with an audible escape of air. Watch the system pressure and note the pressure fall-off for a 10-minute period. If the pressure drop exceeds 1 psi/minute from either service reservoir, inspect the vehicle air systems for sources of leakage and repair them. Refer to troubleshooting information in Bendix or Haldex service literature.
3. Check for excessive leakage around the purge valve with the compressor in the loaded mode (compressing air). Apply a soap solution to the purge valve exhaust port and observe that leakage does not exceed a 1-inch (25-mm) bubble in 1 second. If the leakage exceeds the maximum specified, refer to troubleshooting information in the Bendix or Haldex service literature.
4. Build system pressure to governor cutout and note that the dryer purges with an audible escape of air. Fan the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by a dryer purge. If the system does not follow this pattern, refer to troubleshooting information in the Bendix or Haldex service literature.
5. Check the operation of the end cover heater and thermostat assembly during cold weather operation as follows:

   5.1 Electric Power to the Dryer: With the ignition in the ON position, check for voltage to the heater and thermostat assembly using a voltmeter or testlight. Unplug the electrical connector at the air dryer and place the test leads on each of the connections of the female connector on the vehicle power lead. If there is no voltage, look for a blown fuse, broken wires, or corrosion in the vehicle wiring harness. Check to see if a good ground path exists.

   5.2 Thermostat and Heater Assembly Operation: These tests are not possible except in cold weather operation. Turn off the ignition switch and cool the thermostat and heater assembly to below 40°F (4°C). Using an ohmmeter, check the resistance between the electrical pins in the air dryer connector half. The resistance should be 1.5 to 3.0 ohms for the 12-volt heater assembly and 6.0 to 9.0 ohms for the 24-volt heater assembly.

   NOTE: Some models of the AD–9 may have a resistance reading of 1.0 to 2.5 ohms.

   Warm the thermostat and heater assembly to approximately 90°F (32°C) and again check the resistance. The resistance should exceed 1000 ohms. If the resistance values obtained are within the stated limits, the thermostat and heater assembly is operating properly. If the resistance values obtained are outside the stated limits, replace the heater and thermostat assembly.

42–09 Versajust Slack Adjuster Inspection and Lubrication

IMPORTANT: Perform the **Brake Inspection** maintenance operation before lubricating the slack adjusters.

1. Visually check for physical damage, such as broken air lines and broken or missing parts.
2. Using a quality multipurpose chassis lubricant, NLGI Grade 2, lubricate the slack adjuster through the grease fitting until clean lubricant flows from the grease relief opening in the boot.
3. Perform the "In Service Inspection."

In Service Inspection

1. Apply and release the brakes several times while observing the slack adjuster. The slack adjuster and brake actuator should move freely, without binding or interference, and should return to the full released position. Observe the looseness that exists between the clevis and adapter bushing and the yoke and link pins and their mating parts (clevis, body, link). Replace these parts if looseness appears excessive. Make certain the brake actuator pushrod jam nut is tightened securely.

2. Inspect the slack adjuster for physical damage, paying attention to the link, boot, and clevis. If any components are damaged, repair or replace them as necessary.
3. Measure the brake actuator pushrod stroke while making an 80 to 90 psi (552 to 621 kPa) brake application. Actuator pushrod strokes should not exceed the values shown in **Table 3** and **Table 4**. To achieve the correct pressure for this test, build the system pressure up to a 100 psi (690 kPa). Shut down the engine. Fan the brakes to attain a 90 to 95 psi (621 to 655 kPa) reading. Make and hold a full brake application while the strokes are checked.

Actuator Stroke–Standard Stroke	
Brake Actuator Size	**Recommended Maximum Operating Stroke (Inches)**
30	2
24	1-3/4
20	1-3/4
16	1-3/4
12	1-3/8

Table 3, Actuator Stroke–Standard Stroke

Actuator Stroke–Long Stroke	
Brake Actuator Size	**Recommended Maximum Operating Stroke (Inches)**
30 Long Stroke	2-1/2
24 Long	2
24 Long Stroke	2-1/2
20 Long	2
16 Long	2

Table 4, Actuator Stroke–Long Stroke

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Drag Link Lubricating	46–01
Power Steering Hose Checking	46–02
Power Steering Reservoir Fluid and Filter Changing	46–05
Safety Precautions	46–00
Steering Driveline Lubricating	46–03
Steering Gear Bolts Torque Checking	46–04

46–00 Safety Precautions

Saftey Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

46–01 Drag Link Lubricating

NOTICE

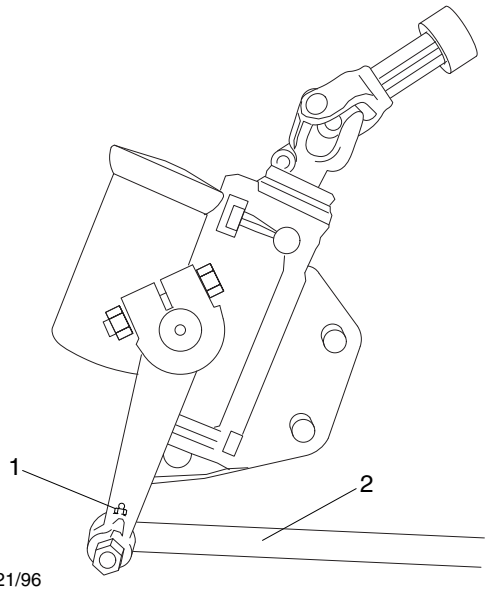
If a power washer is used to clean the chassis in the area of the drag link ends, you must adjust the drag link lubrication intervals. If the vehicle is power-washed often, you must lubricate the drag link more frequently.

1. Using a clean rag, wipe the dirt from both grease fittings on the drag link. See **Fig. 1**.
2. Using a pressure gun, apply multipurpose chassis grease at the grease fittings until old grease is forced out of the socket.

NOTE: Use multipurpose chassis grease NLGI grade 1 (6% 12-hydroxy lithium stearate grease) or NLGI grade 2 (8% 12-hydroxy lithium stearate grease). The grade 2 chassis grease is preferred.

46–02 Power Steering Hose Checking

Check the power steering hoses for chafing. Also, check for leakage around the fittings. Replace any damaged hoses, and tighten all fittings to stop leakage.



1. Grease Fitting
2. Drag Link (pitman arm end shown)

Fig. 1, Steering Drag Link Lubricating

46–03 Steering Driveline Lubricating

Wipe the grease fittings clean. See **Fig. 2**. Using a pressure gun, apply a lithium-based grease (NLGI grade 2) sparingly to the universal joints and slip-joint splines.

46–04 Steering Gear Bolts Torque Checking

Tighten the steering gear mounting bolt nuts, pitman arm pinch-bolt nut, and steering driveline end yoke pinch-bolt nuts to the specifications in **Table 1**. See **Fig. 2** and **Fig. 3**. After the end yoke pinch-bolt nuts have been torqued, apply white Torque Seal F–900 to the exposed pinch-bolt thread and locknut.

Steering System Torque Values		
Description	**Size**	**Torque: lbf·ft (N·m)**
Pitman Arm Pinch-Bolt Hexnut	5/8–11	190 (258)

Steering System Torque Values		
Description	**Size**	**Torque: lbf·ft (N·m)**
Steering Gear to Mounting Bracket		
Flanged Capscrew	M16 x 2 x 55	170–180 (230–244)
Flanged Capscrew	M16 x 2 x 60	170–180 (230–244)
Countersunk Capscrew	M16 x 2 x 50	150 (203)
Steering Driveline		
Upper End Yoke Pinch-Bolt Nut	7/16–20	47 (64)
Lower End Yoke Pinch-Bolt Nut	7/16–20	47 (64)

Table 1, Steering System Torque Values

If the steering driveline end yoke pinch-bolt nut(s) is loose, disassemble and check the input shaft serrations, upper column and jacket assembly wheel tube shaft serrations, and steering driveline end yoke serrations for wear or damage. If worn or damaged, replace the parts as necessary, following the instructions in **Group 46** of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

⚠ WARNING

Failure to tighten the steering gear pinch-bolt nuts to the recommended torque value could cause disengagement of the components and loss of steering control, possibly resulting in personal injury or property damage.

46–05 Power Steering Reservoir Fluid and Filter Changing

Diesel Engine

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the rear tires.
2. Remove the retaining clamp, cover, and cover gasket.
3. Drain the power steering reservoir by disconnecting the power steering hydromax return hose from the reservoir. Keep the hose in an upright position to prevent drainage of fluid. See **Fig. 4**.
4. Catch the fluid from the reservoir in a drain pan, then cap the reservoir port.
5. Unscrew and remove the 10-micron filter that is located on the bottom of the power steering fluid reservoir.
6. Thoroughly clean the reservoir with a lint-free cloth.
7. Install a new filter element. Tighten the filter element finger-tight, then tighten one-eighth of a turn past finger-tight.
8. Connect the hydromax return hose to the power steering fluid reservoir.

⚠ WARNING

Fill only with approved clean fluid. Do not mix fluid types. Any mixture or any unapproved fluid could lead to seal deterioration and leaks. Fluid leakage could cause loss of power steering assist, possibly resulting in personal injury and property damage.

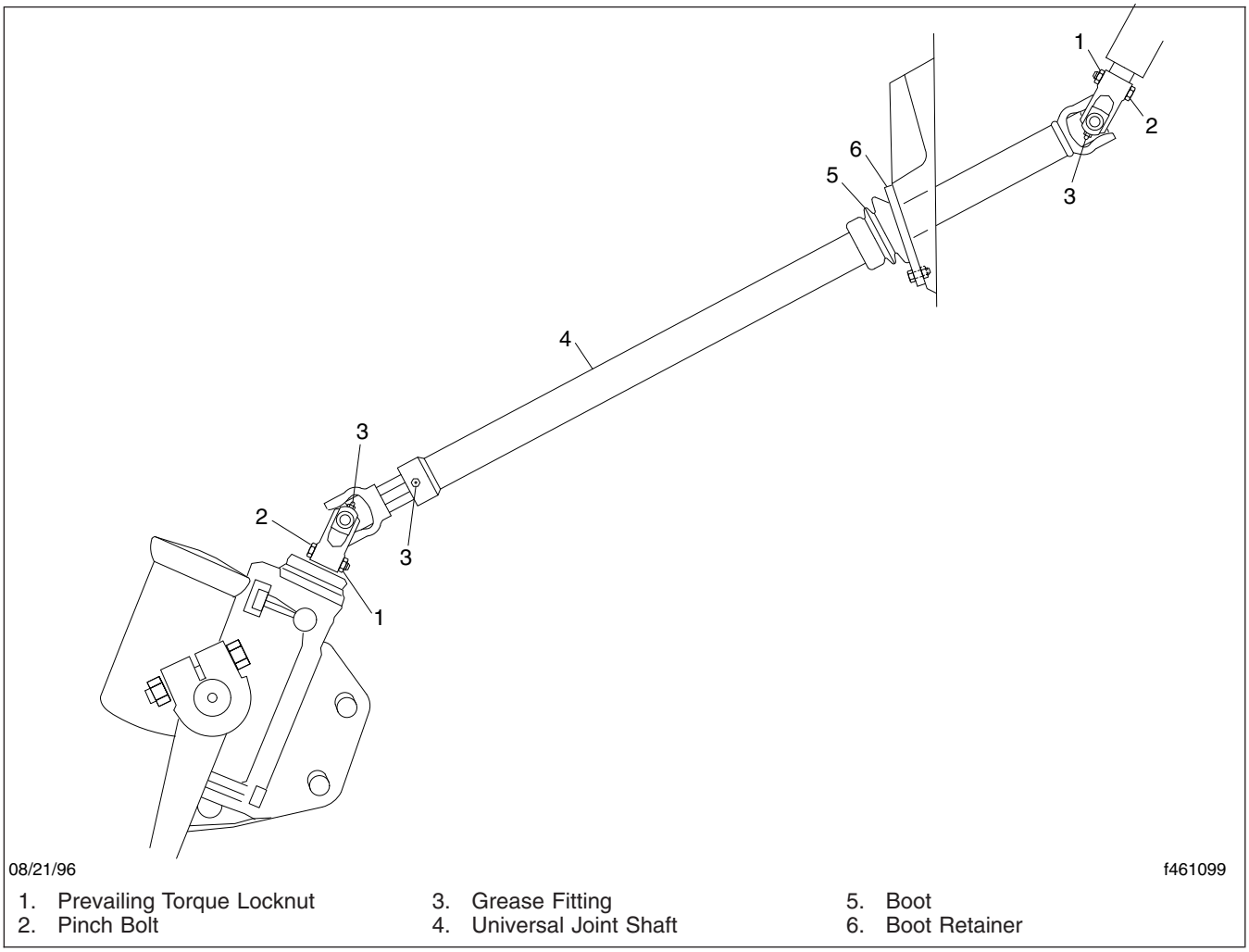
9. Fill the reservoir with Dexron® III automatic transmission fluid (ATF), or an equivalent.

NOTE: When assembling power steering parts, use the same lubricant that is currently in the power steering system. See the warning above.

10. Start the engine and let it idle. Have someone turn the steering wheel to full-lock left and full-lock right until no bubbles are seen in the reservoir. Turn off the engine.
11. Install a new cover gasket, cover, and retaining clamp until firmly seated.
12. Check the power steering reservoir fluid level. If the fluid level is low, add approved fluid to bring the level up to the full mark on the dipstick.

Gasoline Engine

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the rear tires.



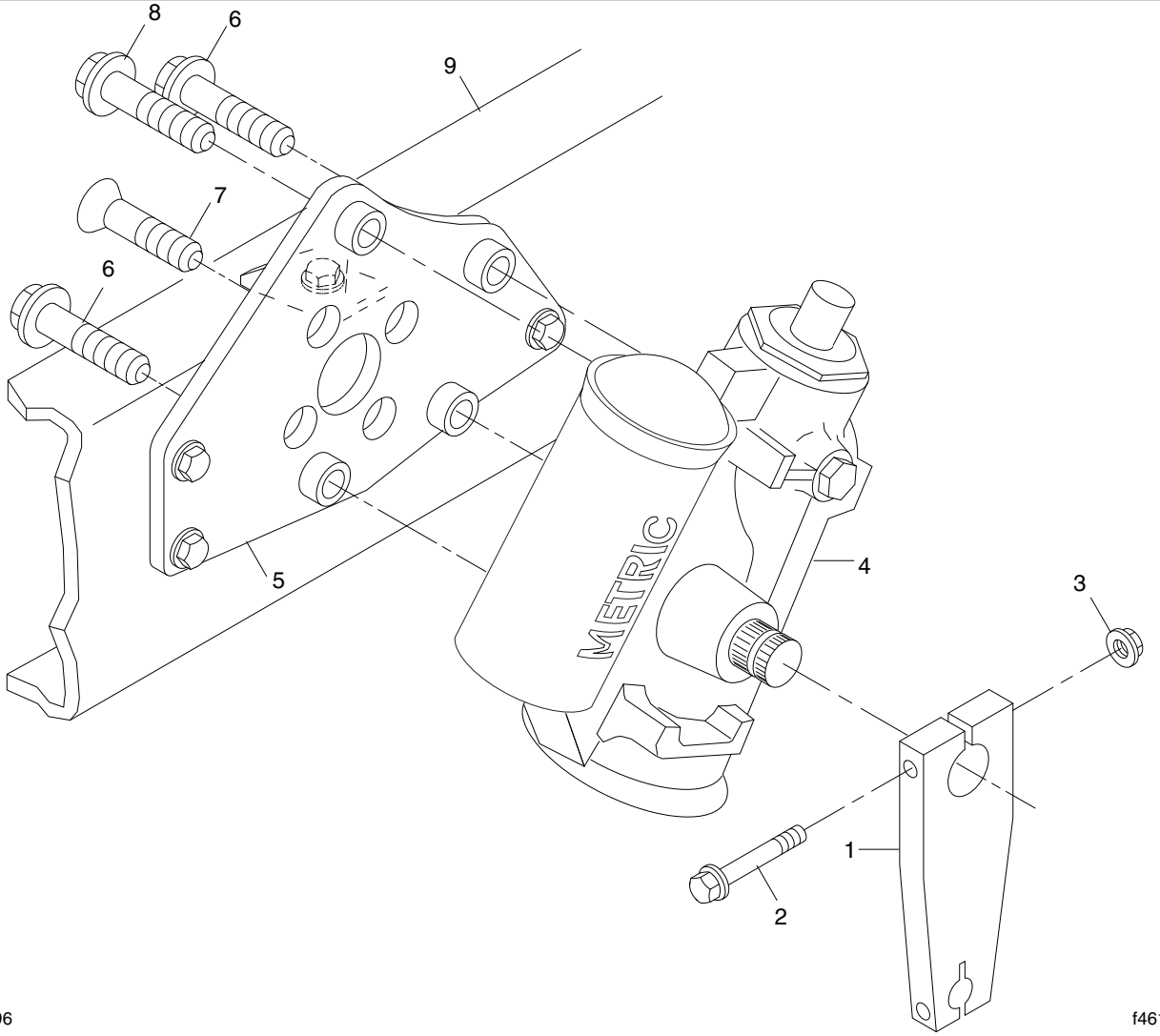
1. Prevailing Torque Locknut
2. Pinch Bolt
3. Grease Fitting
4. Universal Joint Shaft
5. Boot
6. Boot Retainer

Fig. 2, Steering Driveline

2. Remove the reservoir cap and unscrew the power steering fitting shown in **Fig. 5**. Gently pull the fitting away from the reservoir.
3. Place a drain pan under the reservoir.
4. Drain the power steering reservoir by disconnecting the power steering return hose from the reservoir. Keep the hose in an upright position to prevent drainage of fluid.
5. Thoroughly clean the reservoir with a lint-free cloth.
6. Remove the filter located at the power steering fitting. See **Fig. 5**.
7. Install a new filter. Tighten the power steering fitting finger-tight, then tighten one-eighth of a turn past finger-tight.
8. Connect the return hose to the power steering fluid reservoir.

⚠ WARNING

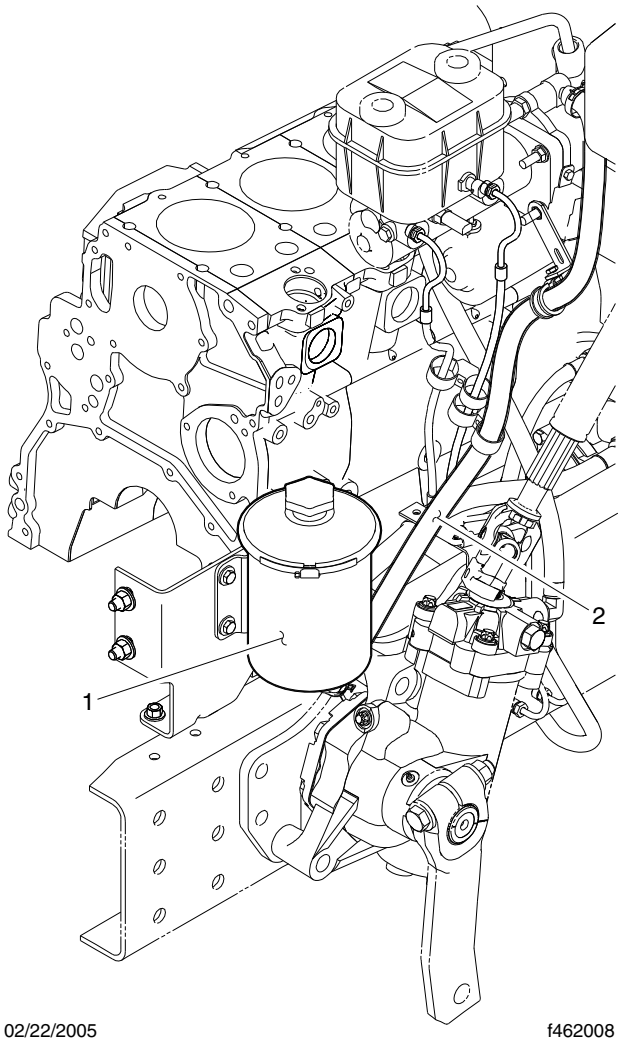
Fill only with approved clean fluid. Do not mix fluid types. Any mixture or any unapproved fluid could lead to seal deterioration and leaks. Fluid leakage could cause loss of power steering assist, possibly resulting in personal injury and property damage.



1. Pitman Arm
2. Pitman Arm Pinch Bolt
3. Pitman Arm Pinch-Bolt Nut
4. Steering Gear
5. Mounting Bracket
6. Flanged Capscrew, M16 x 2 x 60
7. Countersunk Capscrew, M16 x 2 x 50
8. Flanged Capscrew, M16 x 2 x 55
9. Frame Rail

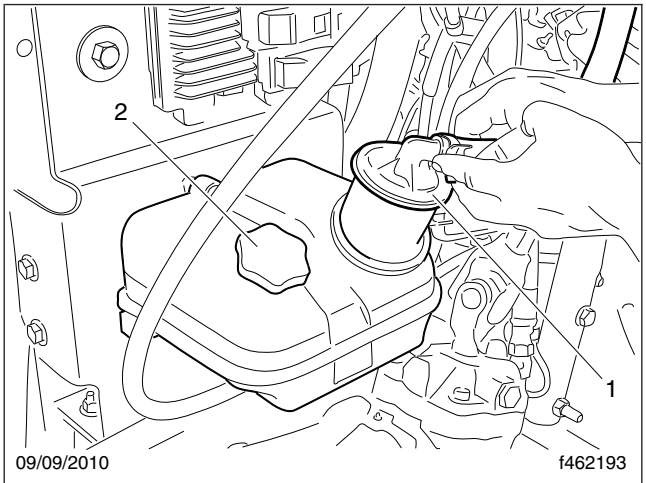
Fig. 3, Saginaw Model 710 Steering Gear Installation

9. Fill the reservoir with Dexron III automatic transmission fluid (ATF), or an equivalent and install the reservoir cap.
10. Start the engine and let it idle. Have someone turn the steering wheel to full-lock left and full-lock right until no bubbles are seen in the reservoir. Turn off the engine.
11. Check the power steering reservoir fluid level. If the fluid level is low, add approved fluid to bring the level up to the full mark on the dipstick.



1. Power Steering Fluid Reservoir
2. Hydromax Return Hose

Fig. 4, Power Steering Reservoir



1. Power Steering Fitting 2. Reservoir Cap

Fig. 5, Steering Reservoir, Gasoline Engine

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
CNG Fuel Block Housing Draining	47–04
CNG Fuel Leak Test	47–02
CNG Fuel Tank Visual Inspection	47–07
CNG High-Pressure Fuel Filter Draining	47–03
CNG High-Pressure Fuel Filter Replacement	47–01
CNG Low-Pressure Fuel Filter Draining	47–06
CNG Low-Pressure Fuel Filter Replacement	47–05
Diesel Fuel Filter Replacement	47–08
Fuel Filter Replacement, Propane Engine	47–12
Fuel Rail Fitting and Injector Inspection, Propane Engine	47–11
Fuel Tank and Line Inspection, Propane Engine	47–10
Gasoline Fuel Filter Replacement	47–09
Safety Precautions	47–00

47–00 Safety Precautions

Saftey Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

47–01 CNG High-Pressure Fuel Filter Replacement

⚠ WARNING

Compressed natural gas is highly flammable. See the safety precautions listed in Chapter 10 of the *Walk-In Van Chassis Operator's Manual* or Group 47 of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer. Failure to observe these precautions could lead to the ignition of the natural gas, which could cause severe bodily harm, or death, or property damage.

The high-pressure fuel filter is located inside of the left-hand frame rail, near the rear of the fuel tank.

1. Shut off the fuel supply at the tanks.
2. Vent the fuel supply system.
3. After the system has been vented, remove the filter housing. See **Fig. 1**.
4. Remove and discard the O-ring used to seal the filter housing.
5. Remove and discard the filter element.
6. Install the new element and press it into place.
7. Install the new O-ring.
8. Apply a thread lubricant to the housing threads, and screw the filter housing onto the filter head.
9. Check for leaks using a natural gas detector.
10. Tighten the filter housing.
11. Turn the fuel supply back on at the tanks.

47–02 CNG Fuel Leak Test

⚠ WARNING

Compressed natural gas is highly flammable. See the safety precautions listed in Chapter 10 of the *Walk-In Van Chassis Operator's Manual* or Group 47 of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer. Failure to observe these precautions could lead to the ignition of the natural gas, which could cause severe bodily harm, or death, or property damage.

Inspect and test the fuel tanks and the fuel lines. Use a natural gas detector to check for any leaks.

Replace leaking fuel tanks; repair or replace any lines or connections that are leaking. For procedures, see **Group 47** of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

Safety precautions are listed in **Group 47** of the *Walk-In Van Chassis Workshop Manual*.

47–03 CNG High-Pressure Fuel Filter Draining

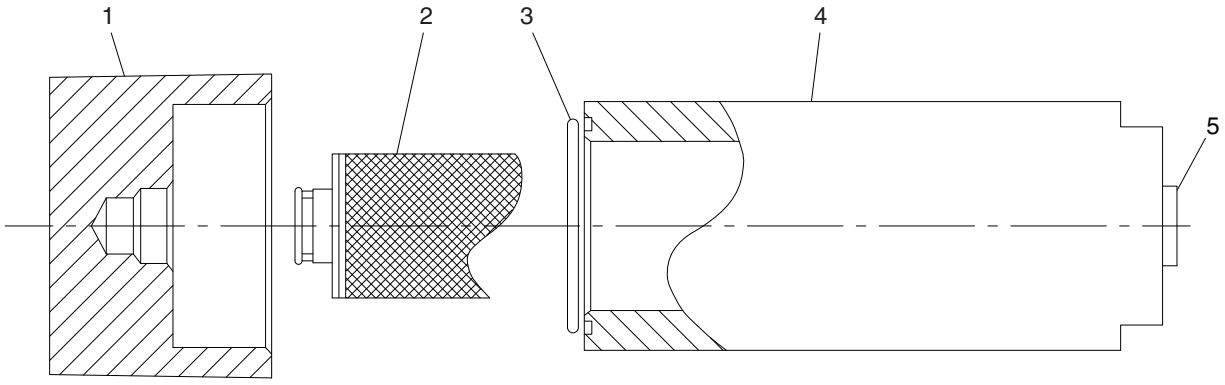
⚠ WARNING

Compressed natural gas is highly flammable. See the safety precautions listed in Chapter 10 of the *Walk-In Van Chassis Operator's Manual* or Group 47 of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer. Failure to observe these precautions could lead to the ignition of the natural gas, which could cause severe bodily harm, or death, or property damage.

Shut off the fuel supply at the fuel tanks. Vent the system.

Drain the fuel filters, which are mounted on the left-hand frame rail of the vehicle near the fuel regulator, by removing the drain nut located at the bottom of the housing of each filter.

Perform this maintenance procedure as indicated in the maintenance interval chart in this manual.



1. Fuel Filter Head
2. Filter Element
3. O-Ring
4. Filter Housing
5. Filter Drain

Fig. 1, CNG High-Pressure Fuel Filter Assembly

47–04 CNG Fuel Block Housing Draining

WARNING

Compressed natural gas is highly flammable. See the safety precautions listed in Chapter 10 of the *Walk-In Van Chassis Operator's Manual* or Group 47 of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer. Failure to observe these precautions could lead to the ignition of the natural gas, which could cause severe bodily harm, or death, or property damage.

Shut off the fuel supply at the fuel tanks. Vent the system.

Remove the drain nut at the bottom of the engine internal fuel filter, which is mounted on the left-hand side of the engine.

Perform this maintenance procedure as indicated in the maintenance interval chart in this manual.

See the engine manufacturer's operation and maintenance manual for further information.

47–05 CNG Low-Pressure Fuel Filter Replacement

WARNING

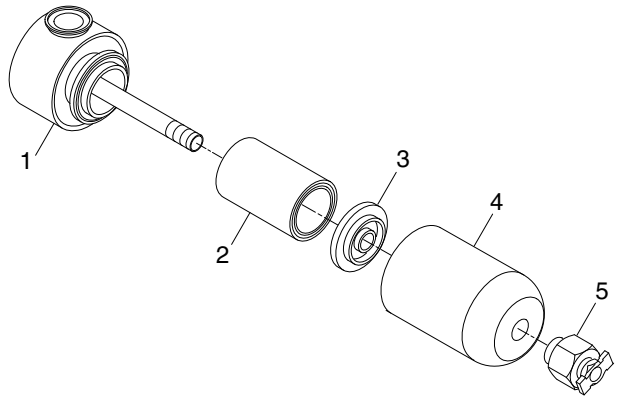
Compressed natural gas is highly flammable. See the safety precautions listed in Chapter 10 of the *Walk-In Van Chassis Operator's Manual* or Group 47 of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer. Failure to observe these precautions could lead to the ignition of the natural gas, which could cause severe bodily harm, or death, or property damage.

The low-pressure fuel filter is located inside of the left-hand frame rail, near the center of the fuel tank.

Turn the valve counterclockwise to close the filter drain.

1. Shut off the fuel supply at the tanks.
2. Vent the fuel supply system.
3. After the system has been vented, remove the filter bowl. See **Fig. 2**. Using a 26-mm wrench, remove the bowl nut. Then remove the bowl, the element retainer, and the filter element.

NOTE: Be sure that the O-ring is positioned properly inside of the filter head.



1. Fuel Filter Head
2. Filter Element
3. Element Retainer
4. Filter Bowl
5. Bowl Nut

Fig. 2, CNG Low-Pressure Fuel Filter Assembly

4. Install the new element, the element retainer, the bowl, and the bowl nut.
5. Turn the fuel supply on at the tanks.

47–06 CNG Low-Pressure Fuel Filter Draining

⚠ WARNING

Compressed natural gas is highly flammable. See the safety precautions listed in Chapter 10 of the *Walk-In Van Chassis Operator's Manual* or Group 47 of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer. Failure to observe these precautions could lead to the ignition of the natural gas, which could cause severe bodily harm, or death, or property damage.

Shut off the fuel supply at the fuel tanks.

Drain the fuel filters, which are mounted on the left-hand frame near the fuel regulator, by removing the drain nut located at the bottom of the housing of each filter.

Perform this maintenance procedure as indicated in the maintenance interval chart in this manual.

47–07 CNG Fuel Tank Visual Inspection

⚠ WARNING

Compressed natural gas is highly flammable. See the safety precautions listed in Chapter 10 of the *Walk-In Van Chassis Operator's Manual* or Group 47 of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer. Failure to observe these precautions could lead to the ignition of the natural gas, which could cause severe bodily harm, or death, or property damage.

Each fuel tank must be visually inspected at specified intervals for external damage and deterioration. The inspection must be performed by a qualified person, in accordance with the manufacturer's established reinspection criteria and Compressed Gas Association documents.

Perform this maintenance procedure as indicated in the maintenance interval chart in this manual. See **Table 1** for the remedies to any damage found on the tank. See **Group 47** of the *Walk-In Van Chassis Workshop Manual* for tank repair procedures, or take the vehicle to an authorized Freightliner dealer.

CNG Tank Visual Inspection		
Damage	**Condition**	**Remedy**
Abrasion on the Fiberglass Wrap	Less Than 0.010 Inch (0.3 mm) Deep	No repair needed.
	More Than 0.010 Inch (0.3 mm) But Less Than 0.030 Inch (0.8 mm) Deep	Repair.
	More Than 0.030 Inch (0.8 mm) Deep	Replace tank.

CNG Tank Visual Inspection		
Damage	**Condition**	**Remedy**
Cuts in the Fiberglass Wrap	Less Than 0.020 Inch (0.5 mm) Deep	No repair needed.
	More Than 0.020 Inch (0.5 mm) But Less Than 0.030 Inch (0.8 mm) Deep	Repair if less than 8 inches (200 mm) long.
	More Than 0.030 Inch (0.8 mm) Deep	Replace tank.
Dents on Metal Ends	Less Than 0.060 Inch (1.6 mm) Deep	No repair needed
	More Than 0.060 Inch (1.6 mm) Deep	Replace tank.
Gouges on Metal Ends	Bare Metal is Exposed	Replace tank.
Chipped Paint on Tank Ends	No Gray Primer Seen	No repair is needed.
	Gray Primer Seen, But Not Damaged	Repair with two-part epoxy resin.
	Gray Primer Damaged	Repair. Sand and remove rust, clean with pre-paint solvent, apply cold-galvanizing zinc primer and apply two-part epoxy resin.
Stress Cracks from Acid	Cracks in Fiberglass	Remove tank for inspection if exposed to acid. Replace if cracks are seen. Replace strap gaskets if exposed to acid.
Strap Gaskets	Gaskets Damaged or Missing	Approved gaskets must be installed between strap and tank. Replace strap gaskets if exposed to acid.
Tank Shield	Shield is Damaged	Repair or replace shield.
Tank Is Old	Tank is 15 Years Old	Replace tank after 15 years from date on label.
Vehicle Was in Accident or Fire	Tank Was Hot or Damaged From Impact.	Replace tank or remove tank and test.

Table 1, CNG Tank Visual Inspection

47–08 Diesel Fuel Filter Replacement

Davco Fuel Pro® 382 Fuel/Water Separator Filter Replacement

Replace the fuel/water separator element only when the filter element is completely covered.

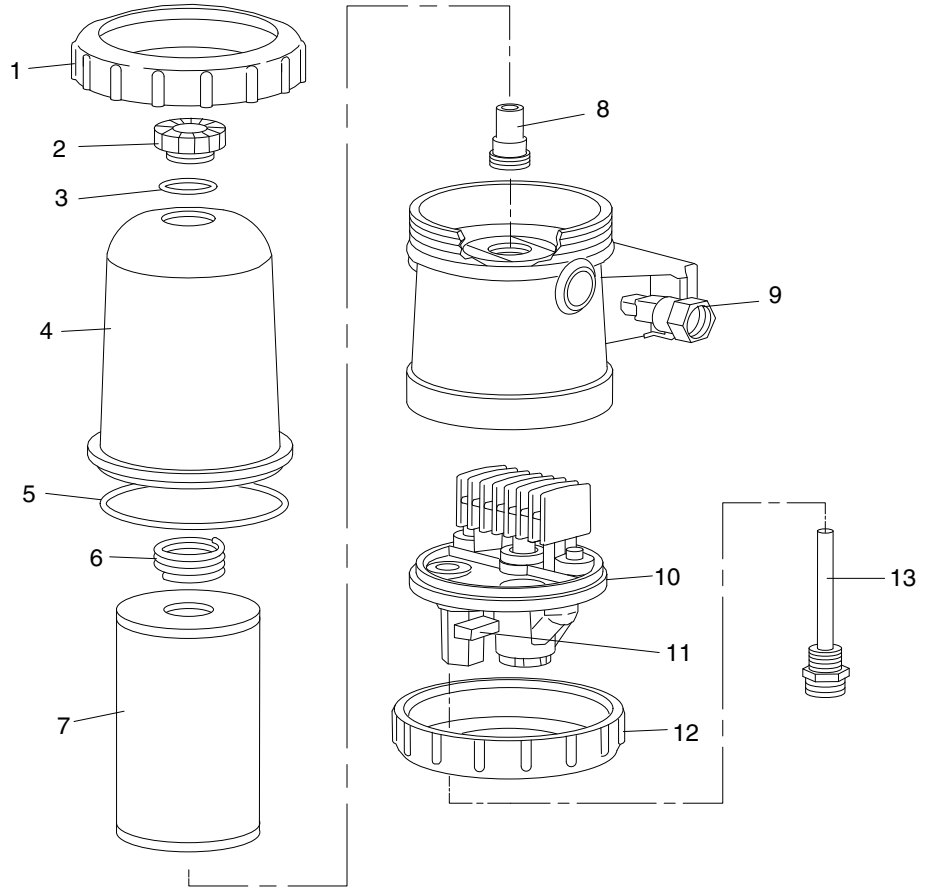
⚠ WARNING

Diesel fuel is flammable and can ignite if exposed to an open flame, intense heat, or other ignition source. Do not drain fuel near, or expose fuel vapor to open flame or intense heat. Exposure to open flame or intense heat could start a fire, possibly resulting in personal injury or property damage. When working on a fuel system, have a fire extinguisher within easy reach.

1. Place a suitable drain pan under the fuel/water separator and open the drain valve. Drain enough fuel to empty the filter, then close the drain valve. See **Fig. 3**.
2. Using Davco wrench 380134 or 382002, remove the filter collar. Then remove the filter cover.
3. Remove the element and dispose of it properly.
4. Install a new element. Make sure the grommet is in place on the filter stud.
5. Install a new cover seal on the filter cover.
6. Using the collar, attach the filter cover with the spring to the base.

IMPORTANT: Tighten the collar by hand only.

7. Remove the filter vent. Then fill the fuel/water separator with fuel until the fuel level is 1 inch (2.5 cm) above the collar.
8. Install the filter vent on the fuel/water separator.



1. Filter Collar
2. Filter Vent
3. Vent Seal
4. Filter Cover
5. Cover Seal
6. Filter Spring
7. Filter Element
8. Temporary Filter Stud
9. Check Valve Fuel Inlet
10. Fluid Heater/Bottom Plate and Seal
11. Drain
12. Bottom Plate Collar
13. Electric Heater (optional)

Fig. 3, Davco Fuel Pro 382 (exploded view)

9. Start the engine and raise the rpm for 1 minute to purge air.

Alliance Fuel/Water Separator Element Replacement

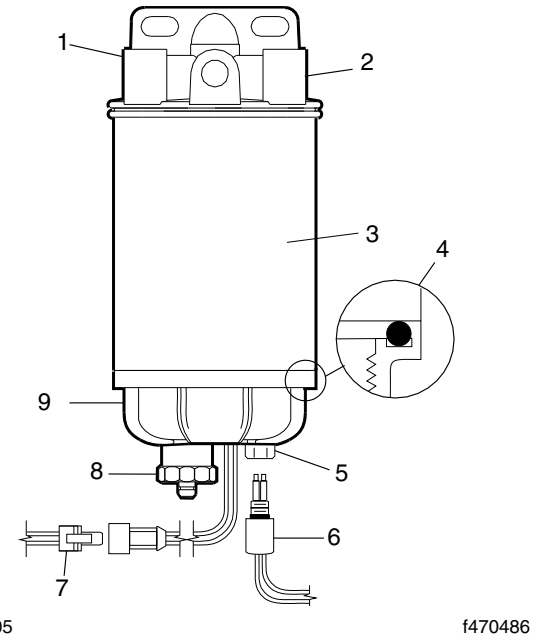
The only maintenance necessary on an Alliance fuel/water separator is to replace the filter element.

⚠ WARNING

Diesel fuel is flammable and can ignite if exposed to an open flame, intense heat, or other ignition source. Do not drain fuel near, or expose fuel vapor to open flame or intense heat. Exposure to open flame or intense heat could start a fire, possibly resulting in personal injury or property damage. When working on a fuel system, have a fire extinguisher within easy reach.

1. Place a suitable drain pan under the fuel/water separator and open the drain valve. Drain

enough fuel to empty the filter, then close the drain valve. See **Fig. 4**.



1. Fuel Outlet
2. Fuel Inlet
3. Filter Element
4. Bowl O-ring
5. Bowl Probe Plug
6. Water Sensor Probe
7. Heater Connector
8. Drain Plug
9. Sight Bowl

Fig. 4, Alliance Fuel/Water Separator

2. Disconnect the water sensor and heater connections if equipped.
3. Remove the element and bowl together by turning counterclockwise.
4. Remove the bowl from the element and clean the O-ring gland.
5. Apply a coating of clean fuel or motor oil to the new O-ring and element seal.
6. Spin the bowl onto the new element, then spin them both onto the filter head snugly by hand only.

IMPORTANT: Do not use tools to tighten the bowl and element.

7. Connect the water sensor and heater connectors if equipped.
8. Start the engine and check for fuel leaks.
9. Shut down the engine and correct any fuel leaks.

47–09 Gasoline Fuel Filter Replacement

The gasoline fuel filter is installed inside the fuel tank. It is recommended that the fuel filter be changed every five years or 150,000 miles (241 350 km), whichever comes first.

47–10 Fuel Tank and Line Inspection, Propane Engine

1. Inspect the tank and fuel lines for damage.
2. Inspect the brackets and fasteners to make sure the tank is securely fastened.
3. Ensure that all service valves and/or shut-off vales work properly.
4. Make certain the pressure relief valve vent is clear of any obstructions. If equipped with a dust cap, ensure that it is securely in place.
5. Use an electronic leak detector or a liquid-leak detection solution to check the tank fittings, connections, and fuel lines for leaks.
6. Check the solenoid wiring and connectors, making certain they are securely attached and locked.

47–11 Fuel Rail Fitting and Injector Inspection, Propane Engine

⚠ WARNING

Liquid propane can cause serious burns should it contact the skin or eyes. When handling propane, always wear protective gloves and eye protection to prevent contact.

Propane is extremely flammable, and can ignite if an ignition source is present, causing burns and other serious injuries. Keep sparks and flames

away from propane. Do not smoke near propane or when refueling the vehicle.

The propane fuel system requires special tools to make repairs. Service and repair of the propane fuel system should only be performed by trained propane service technicians. To prevent personal injury or damage to the fuel system, do not attempt repairs yourself.

See the safety precautions listed in Chapter 17 of the *Walk-In Van Operator's Manual,* or take the vehicle to an authorized Freightliner dealer. Failure to observe these precautions could lead to the ignition of the liquid propane, which could cause property damage, severe bodily harm, or death.

NOTE: The fuel rails and injectors do not require any adjustments.

1. Make certain that all electrical connections are connected and locked.
2. Make certain the fuel rail is securely attached to the engine.
3. Use an electronic leak detector or a liquid-leak detection solution to check all injectors, rails, and fittings for fuel leaks.

47–12 Fuel Filter Replacement, Propane Engine

⚠ WARNING

Liquid propane can cause serious burns should it contact the skin or eyes. When handling propane, always wear protective gloves and eye protection to prevent contact.

Propane is extremely flammable, and can ignite if an ignition source is present, causing burns and other serious injuries. Keep sparks and flames away from propane. Do not smoke near propane or when refueling the vehicle.

The propane fuel system requires special tools to make repairs. Service and repair of the propane fuel system should only be performed by trained propane service technicians. To prevent personal injury or damage to the fuel system, do not attempt repairs yourself.

See the safety precautions listed in Chapter 17 of the *Walk-In Van Operator's Manual,* or take the vehicle to an authorized Freightliner dealer. Failure to observe these precautions could lead to the ignition of the liquid propane, which could cause property damage, severe bodily harm, or death.

The propane system is equipped with two filters—one before the fuel enters the tank, and another before it enters the engine. The replacement procedure that follows applies to both filters. See **Fig. 5**.

NOTICE

Damage may occur to the valve(s) if they are overtightened.

1. Turn the fuel supply and return valves clockwise to shut them off at the tank.

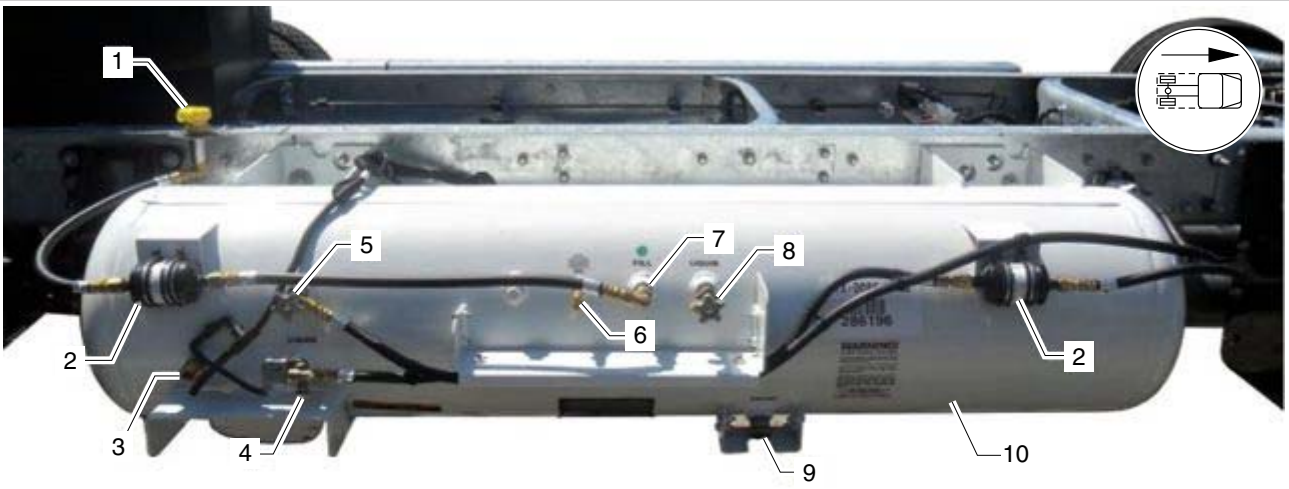
NOTE: Both the fuel supply and return lines must be vented to ensure all pressure is removed from the fuel rails and lines.

⚠ WARNING

Venting the fuel supply and return lines must be performed outside. Do not release propane inside a garage or building. Failure to do so could cause serious bodily injury or death.

2. Vent the system outside in an open area. Slowly crack open the fuel supply and return lines that are connected to the supply and return valves until a white mist appears. Continue cracking the lines open until there is absolutely no pressure.

   Once the system is vented, push the vehicle into the shop.
3. Disconnect the fuel supply and return lines from the valves until all service work is finished.
4. Cover the open lines to prevent contaminants from entering the system.
5. Remove and discard the filter.
6. Install the new filter, making certain the arrow on the filter points toward the tank or engine as applicable.
7. Remove the protective cover from the fuel lines.
8. Connect both ends of the filter to the fuel line and tighten 28±10 lbf·ft (38±14 N·m).
9. Connect the fuel lines to their designated supply and return valve. Tighten the fuel line flare nuts 13 lbf·ft (18 N·m).



1. Fill Valve
2. Fuel Filter
3. Electrical Pass-Through
4. Solenoid Valve, Supply
5. Return Shutoff Valve
6. Bleeder Valve
7. 80% Fill-Stop
8. Service Valve
9. Pressure Relief Valve
10. Propane Tank

Fig. 5, Propane Tank Assembly

NOTICE

Damage may occur to the valve(s) if they are over-tightened.

10. Turn the fuel supply and return valves counter-clockwise, then start the vehicle in order to charge the fuel lines with propane.
11. Check for leaks using an electronic leak detector or a liquid-leak detection solution.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Exhaust System Inspecting (Noise Emission Control)	49–01
Safety Precautions	49–00

49–00 Safety Precautions

Saftey Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

49–01 Exhaust System Inspecting (Noise Emission Control)

The exhaust system must be free of leaks, binding, grounding, and excessive vibrations. In addition to inspecting the exhaust system at the scheduled maintenance interval, inspect the exhaust system if the noise level of the vehicle has increased. Replace parts that show leakage, wear, or damage, with genuine Freightliner parts.

These conditions are usually caused by loose, broken, or misaligned clamps, brackets, or pipes. If any of these conditions exist, check the exhaust system components and alignment. Align or replace as necessary. For alignment or adjustment instructions, see **Group 49** of the *Walk-In Van Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

EPA10 and Newer Exhaust System

Definitions of Aftertreatment System (ATS) Terms

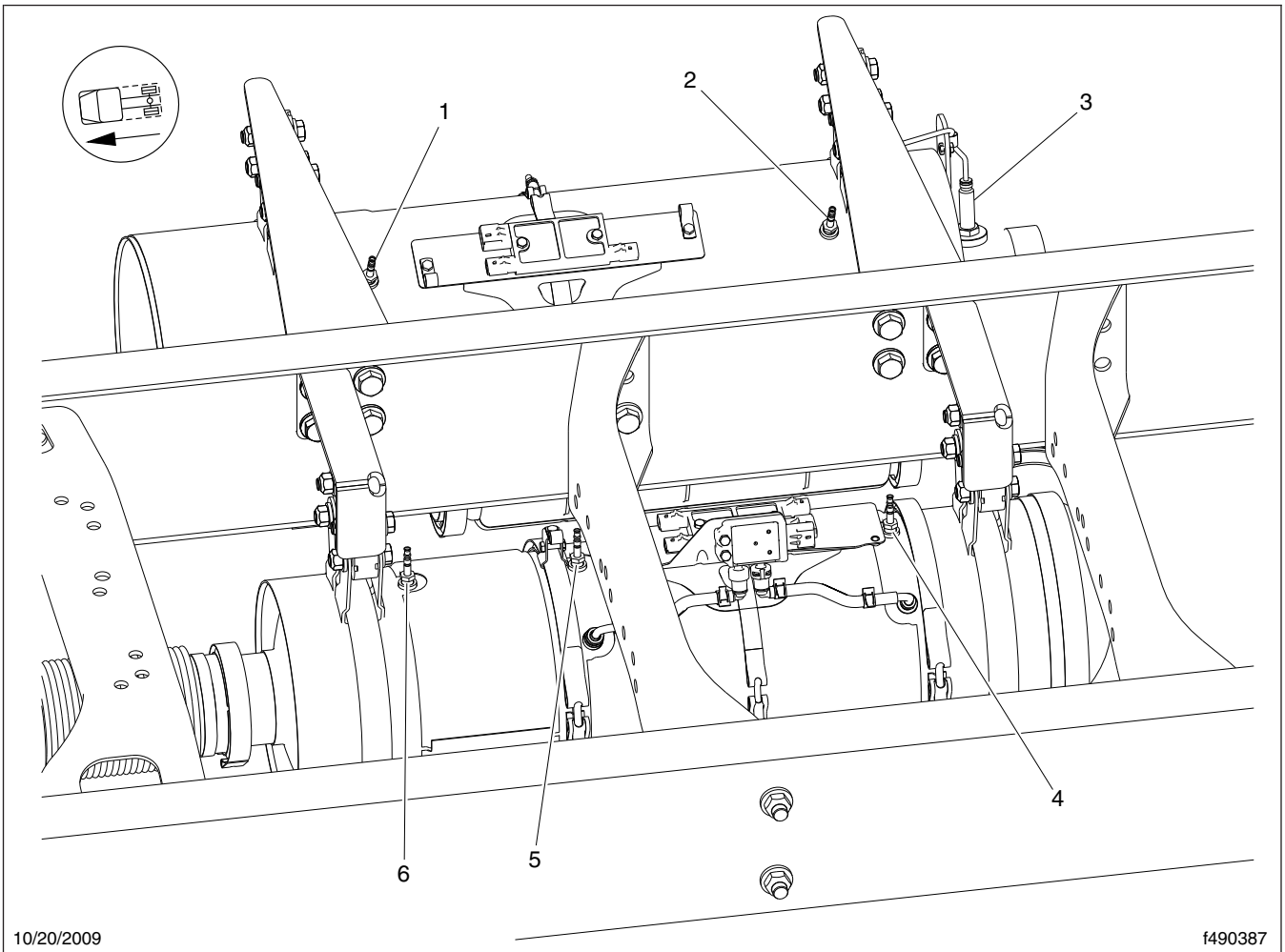
Refer to the following list of definitions of ATS terms and components.

- Aftertreatment System (ATS)—the entire exhaust system from the turbocharger to the tail pipe, including the Selective Catalytic Reduction (SCR) components.
- Aftertreatment Device (ATD)—a device that removes pollutants from exhaust gas after the gas leaves the combustion chamber.
- BlueTec®—Daimler's proprietary SCR technology.
- Diesel Oxidation Catalyst (DOC)—a flow-through device that enhances the oxidation of hydrocarbons in the ATD.
- Diesel Particulate Filter (DPF)—a component in the ATD that traps particulate matter from the exhaust gas.
- Diesel Exhaust Fluid (DEF)—the chemical agent that reacts with the exhaust gases in the SCR to reduce NOx.
- DEF Pump—filters and supplies DEF to the DEF metering unit.
- DEF Tank—holds DEF and regulates its temperature.
- DEF Metering Unit—mixes DEF with compressed air, and meters this mixture into the exhaust flow via an injection nozzle.
- SCR Catalyst—the housing containing a treated ceramic flow-through block where the DEF and exhaust gases undergo selective catalytic reduction.
- Selective Catalytic Reduction (SCR)—a process used to reduce NOx emissions.

Inspection

IMPORTANT: The Environmental Protection Agency's 2010 regulations mandate lowered exhaust emissions, thus requiring exhaust system components that reduce emissions. In particular the aftertreatment device (ATD), which is part of the aftertreatment system (ATS), requires special attention during regularly scheduled maintenance inspections. See **Fig. 1** for Cummins ATD sensor locations. The side-by-side mounting is shown, however, left inline and top side-by-side mountings are possible depending on the chassis design. If any discrepancies are discovered, refer to the engine manufacturer's service literature for repair instructions.

1. Check for leakage at the clamp that attaches the exhaust pipe to the turbocharger exhaust outlet. If leakage exists, tighten the nut on the clamp to



1. SCR Inlet Temperature Sensor
2. SCR Outlet Temperature Sensor
3. SCR Outlet NOx Sensor
4. DPF Outlet Temperature Sensor
5. DPF Catalyst Outlet Temperature Sensor
6. DPF Outlet Temperature Sensor

Fig. 1, Cummins ATD Sensor Locations, Side-by-Side Mounting

the required torque. If leakage persists, install a new clamp.

2. Check the exhaust pipe, bellows, and each exhaust seal clamp for leakage, wear, cracks, or damage. Replace damaged components as needed. If leakage exists at a clamp, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal clamp. Do not reuse seal clamps. Once a seal clamp is loosened or removed, it must be replaced.
3. If present, check the condition of the insulation material around the exhaust pipe between the turbocharger and the ATD.
4. Check the ATD mounting bands for tightness. Tighten to 30 lbf·ft (41 N·m) if needed. Do not overtighten.
5. Check for leaks around the clamps that attach the ATD in the ATS, and around the clamps that retain the DPF in the ATD. No leaks are allowed anywhere in the system.

6. Check all sensors attached to the ATD for leaks or damaged wires. No leaks are allowed.
7. Check the DPF exterior surface for dents or other damage. A dent over 3 inches (76 mm) in diameter and 1/4-inch (6-mm) deep could cause internal damage to the DPF, causing it to malfunction.
8. Check the SCR catalyst for dents and other damage.
9. Check for heat discoloration on the surface of the ATD. Heat discoloration may indicate internal damage; especially around the DPF.

NOTE: Diesel exhaust fluid creeps, causing white crystals to form around the line fittings. The presence of crystals does not mean the system has a leak. Replacing fittings or troubleshooting components is not necessary unless there is a system failure or a fault code.

10. Check the DEF tank, pump, metering unit, and lines for leaks. See **Group 49** of the *Walk-In Van Chassis Workshop Manual* for repair procedures.
11. Check any wires, lines, or hoses within 4 inches (10 cm) of the exhaust system for heat damage. Repair or reroute as needed.

Diesel Exhaust Fluid (DEF) Filter Replacement

The Environmental Protection Agency's 2010 regulations require lower nitrogen oxide (NOx) exhaust emissions. Selective catalytic reduction (SCR) uses diesel exhaust fluid (DEF) to lower NOx emissions in the vehicle exhaust. A filter in the DEF pump prevents clogging of the DEF metering unit injection nozzle.

See the engine manufacturer's maintenance manual for DEF filter replacement instructions and maintenance intervals.

EPA07 Exhaust System Inspecting

Definitions of ATS Components

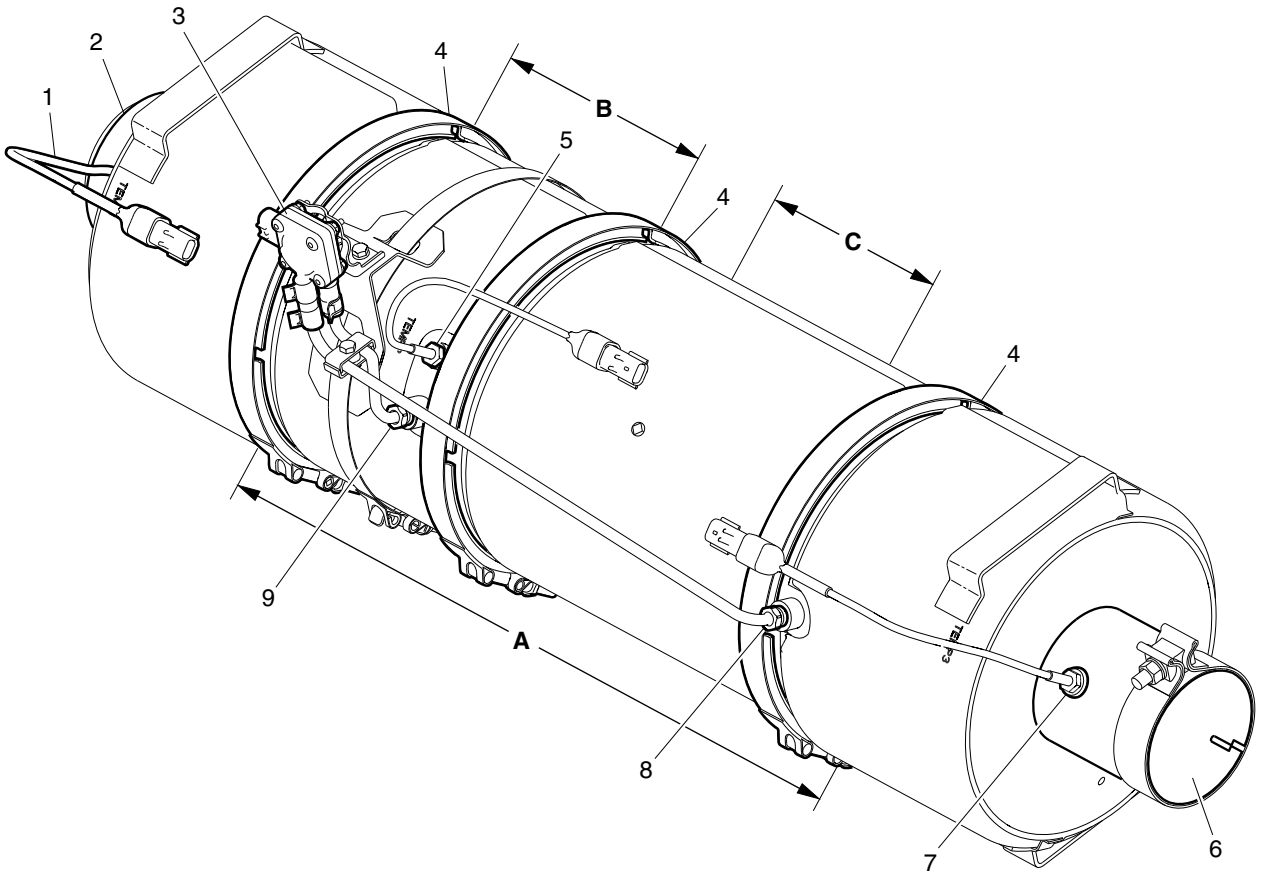
Refer to the following list of definitions of ATS components.

- Aftertreatment System (ATS)—the entire exhaust system from the turbocharger to the exhaust stack or tail pipe.
- Aftertreatment Device (ATD)—a muffler-like canister that houses a DPF and sensors.
- Diesel Particulate Filter (DPF)—a filter that collects and holds particulate matter (soot and ash).
- Diesel Oxidation Catalyst (DOC)—oxidizes hydrocarbons and reduces NOx.
- Sensors—detect temperatures and pressure within the ATS.
- Diffuser—a device, used as a deflector, for distributing, mixing, and reducing the velocity of air flow.

IMPORTANT: The Environmental Protection Agency's 2007 regulations require lower exhaust emissions, thus requiring new exhaust system components. See **Fig. 2**. In particular the aftertreatment device (ATD), which is part of the aftertreatment system (ATS), requires special attention during regularly scheduled maintenance inspections. If any discrepancies are discovered, refer to the engine manufacturer's service literature for repair instructions.

Inspection

1. Check for leakage at the clamp that attaches the exhaust pipe to the turbocharger exhaust outlet. If leakage exists, tighten the nut on the clamp to the required torque. If leakage persists, install a new clamp.
2. Check the exhaust pipe, bellows, and each exhaust seal clamp for leakage, wear, cracks, or damage. Replace damaged components as needed. If leakage exists at a clamp, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal clamp. Do not reuse seal clamps. Once a seal clamp is loosened or removed, it must be replaced.
3. If present, check the condition of the insulation material around the exhaust pipe between the turbocharger and the ATD.
4. Check the ATD mounting bands for tightness. Tighten to 30 lbf·ft (41 N·m) if needed. Do not overtighten.



A. Inspect this area of the canister for dents.
B. DOC Area
1. Inlet Temperature Sensor
2. Marmon Fitting at Inlet from Turbocharger
3. Sensor Housing
4. DPF V-Band Mounting Clamps
5. Inlet Temperature Sensor
C. DPF Area
6. Exhaust Outlet to Diffuser
7. Outlet Temperature Sensor
8. DPF Outlet Pressure Sensor
9. DPF Intake Pressure Sensor

Fig. 2, Cummins Aftertreatment Device

5. Check for leaks around all clamps that attach the ATD in the ATS, and around the clamps that retain the DPF in the ATD. No leaks are allowed anywhere in the system.
6. Check all sensors attached to the ATD for leaks or damaged wires.
7. Check the DPF exterior surface for dents or other damage. See **Fig. 2**, Reference A. A dent over 3 inches (76 mm) in diameter and 1/4-inch (6-mm) deep could cause internal damage to the DPF, causing it to malfunction.
8. Check for heat discoloration on the surface of the ATD. Heat discoloration may indicate internal damage; especially around the DPF.
9. Check any wires, lines, or hoses within 4 inches (10 cm) of the exhaust system for heat damage. Repair or reroute as needed.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Battery Voltage Checking	54–05
Battery, Battery Box, and Cable Checking and Cleaning	54–02
Electrical System Checking	54–04
Ground Cables Checking and Cleaning	54–03
Lighting System Checking	54–01
Safety Precautions	54–00

54–00 Safety Precautions

Saftey Precautions in this section apply to all procedures within this group.

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

54–01 Lighting System Checking

Check all lighting units and wiring for loose connections, corrosion, poor grounds, loose mountings, and pinched or damaged wires; repair or replace as needed.

54–02 Battery, Battery Box, and Cable Checking and Cleaning

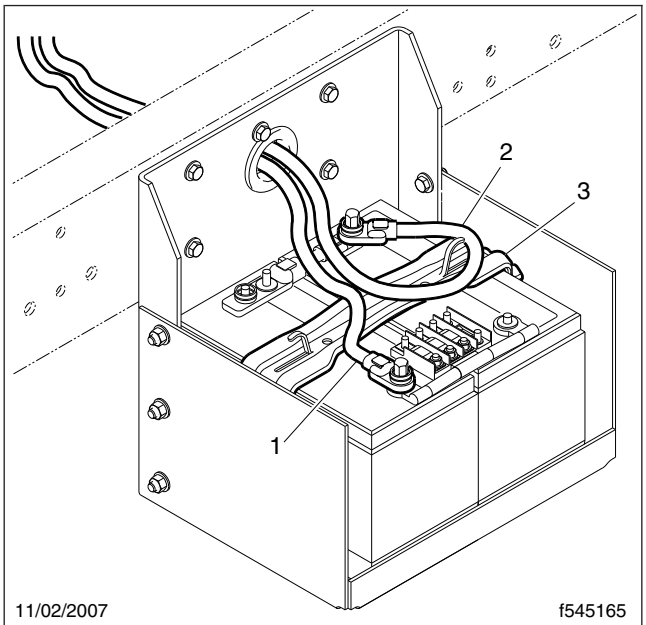
⚠ WARNING

Batteries generate explosive gas as a by-product of their chemical process. Do not smoke when working around batteries. Put out all flames and remove any source of sparks or intense heat in the vicinity of the battery compartment. Make sure the battery compartment has been completely vented before disconnecting or connecting the battery cables.

Battery acid is extremely harmful if splashed in the eyes or on the skin. Always wear a face shield and protective clothing when working around batteries.

1. Remove any corrosion from the battery box and the top of the battery. See **Fig. 1**.

   Use distilled ammonia or a soda solution to neutralize any acid present. Flush off the ammonia or soda solution with clear water.



1. Negative Terminal
2. Positive Terminal
3. Clamp Assembly

Fig. 1, Battery Box

2. Check the battery cases for cracks. Replace a battery if its case is cracked.
3. Disconnect the battery cables from the battery posts, and check for corrosion.

   If corrosion is found, clean the terminals and posts, using a wire brush and a solution of baking soda and water. Use the solution sparingly.
4. Connect the cables to the batteries, and tighten them 10 to 15 lbf·ft (14 to 20 N·m). Spray each connection terminal with dielectric red enamel.
5. Check the battery-to-starter cables. Look for kinking, corrosion, breaks in the insulation, and heat damage. Check that the cable clamps are not bent, damaged, or stripped of insulation.

IMPORTANT: If a battery cable is damaged, replace the entire cable. Never splice a battery cable.

6. Check the mounting fasteners for tightness, and tighten them 60 lbf·ft (81 N·m) if necessary. The battery box must be kept in good condition to support the batteries securely and to keep them level.

NOTICE

Failure to keep the batteries held securely in place could result in battery damage, such as loose plates or posts.

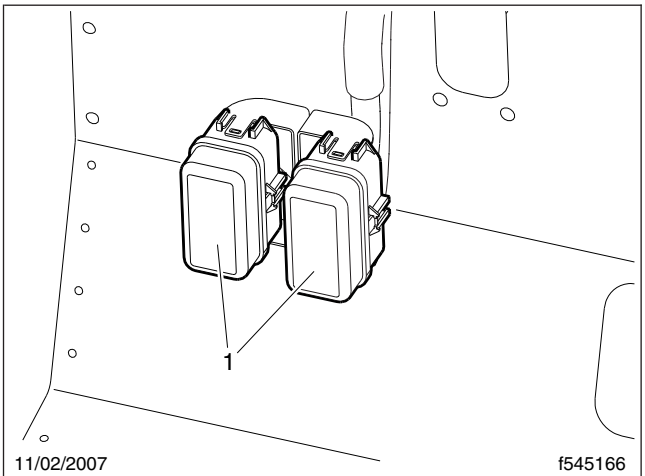
54–03 Ground Cables Checking and Cleaning

Check that the ground cables are clean, undamaged, and tight. If needed, disconnect them, clean the mating surfaces with a soda solution, then connect them securely. Protect the ground cable connections with dielectric red enamel.

54–04 Electrical System Checking

Dash

1. Uncover the electrical power center and remove the fasteners. See **Fig. 2**.



1. Fuse, Relay, and Circuit Breaker

Fig. 2, Electrical Power Center

2. Check the wiring harness for movement that could strain the electrical connections. Install more clamps on the harness, if needed.
3. Check all the wiring for chafing, kinks, and discolored insulation. Find the cause of any problems, then repair, replace, or reroute the wires, as needed.
4. Check that all the relays are firmly seated in their mounting plates.
5. Remove the instrument and control panels and check all the wiring behind them for kinks, chafing, heat damage, and discolored insulation. Reroute, repair, or replace the wires as needed.
6. Check the tightness of all the electrical connections behind the panels. Make sure that all male and female connectors are firmly connected, and check the tightness of the nuts on the ring connectors. Tighten them 30 lbf·in (339 N·cm).
7. Test the electric horn. If it is not fully operational, use the schematics and troubleshooting information in **Section 54.00** and **Section 54.05** of the *Walk-In Van Chassis Workshop Manual* to identify and repair any problems.

Chassis

1. Check the main wiring harness. Check the wiring insulation for damage from chafing or heat. Also check for kinks. Reroute, repair, or replace the wires as needed.
2. Check all the tie straps for breakage or damage. Replace any broken or cracked tie straps.

NOTICE

Do not use flat-strip aluminum tie straps for holding electrical wiring. The sharp edges on these tie straps may cause breaks in the wire insulation, allowing the aluminum tie strap to make contact with the wire. This could cause a short circuit and damage to the wiring.

3. Check all clamps, plastic connectors, and grommets. Replace any that are damaged. Make sure all grommets are fully seated.
4. Check the battery cable connections on the starter for tightness. Make sure they are free of corrosion. Add dielectric grease as needed.
5. Check the magnetic switch terminals and connections for tightness. Protect the magnetic switch terminals with dielectric red enamel as needed.
6. Check the wires of all sensors mounted on or near the engine. Make sure no wires are closer

than 6 inches (15 cm) to hot surfaces. If any are, and they cannot be rerouted, make sure they are protected by heat shields. Check the sensor connectors. Make sure they are tight, clean, and undamaged.

54–05 Battery Voltage Checking

Check the battery open circuit voltage using an accurate voltmeter. If the voltmeter registers 12.5V or below, fully charge the battery to 12.65V. A fully charged battery will have a voltage of 12.65V with the charger disconnected.